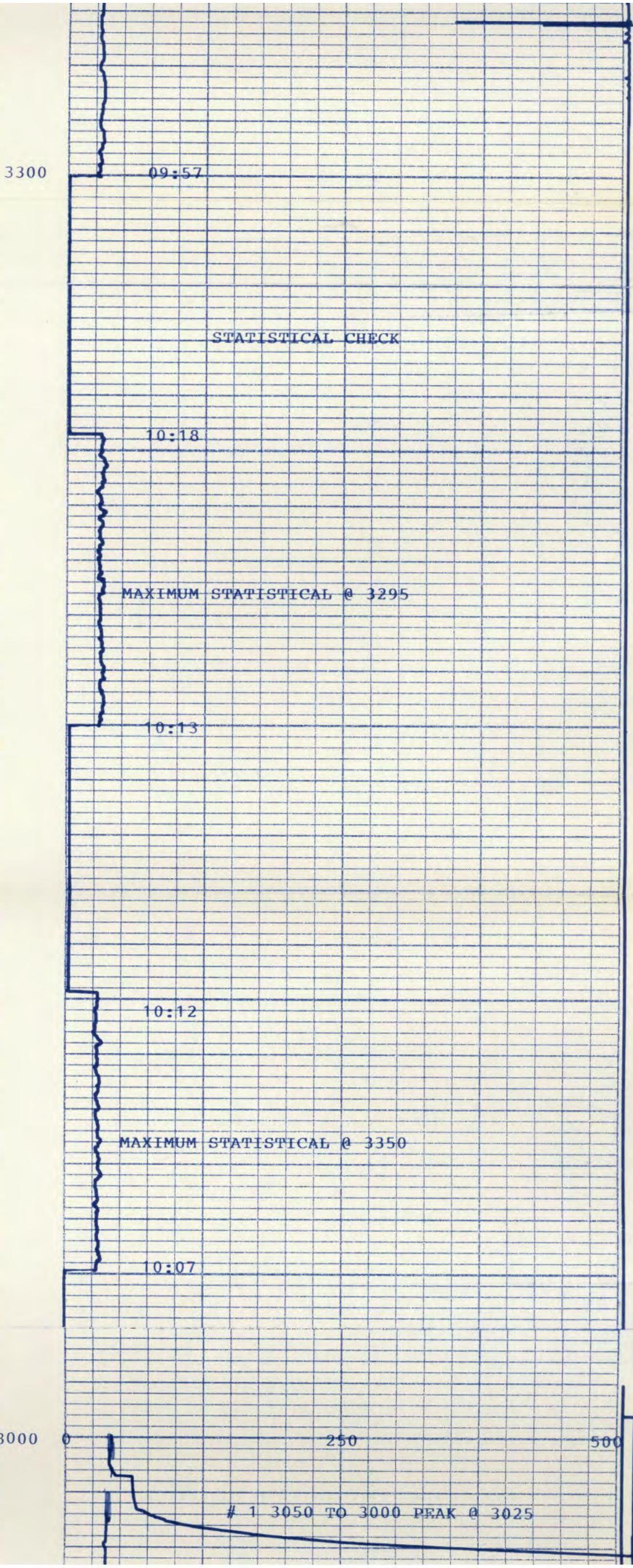
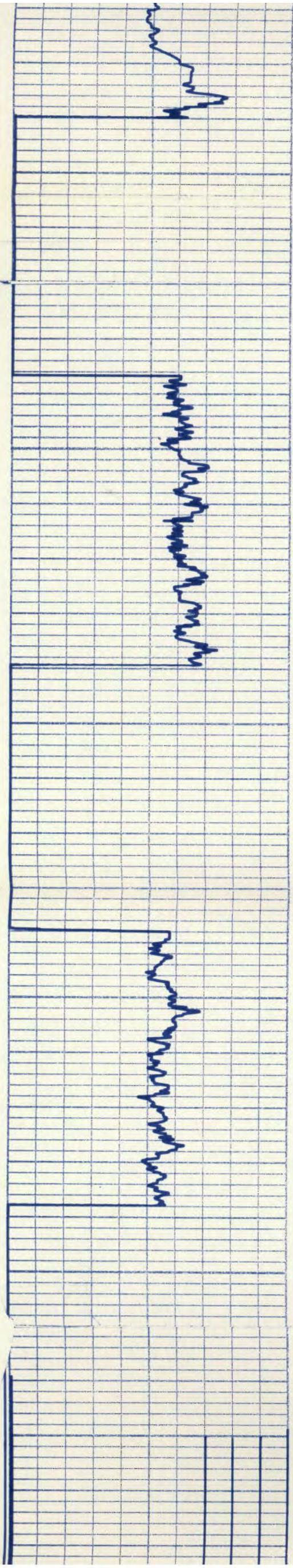


3000

10:05

3100

3200



3100

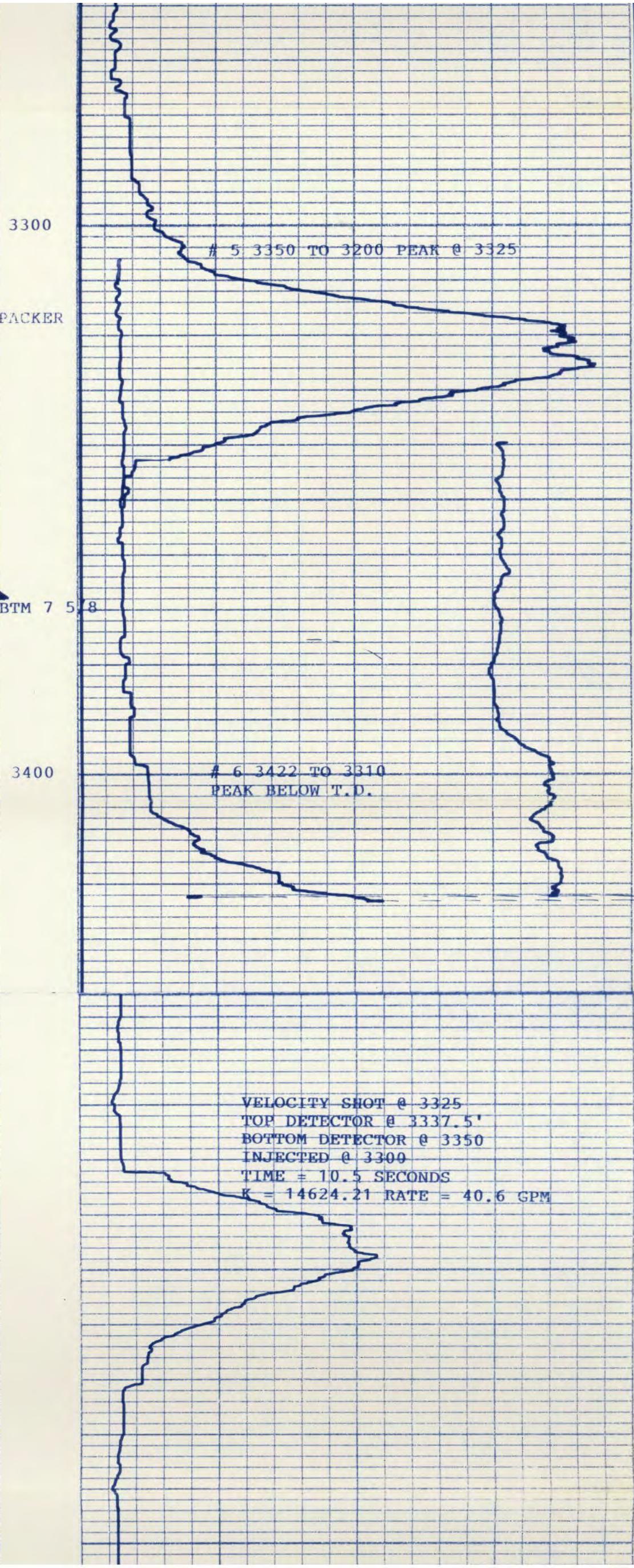
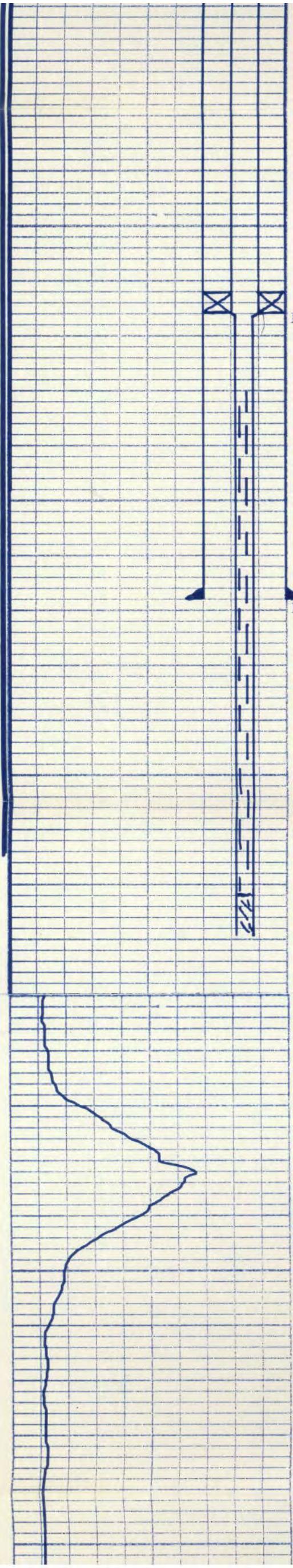
# 1 3050 TO 3000 PEAK @ 3025

3200

# 2 3100 TO 3010 PEAK @ 3072

# 3 3150 TO 3060 PEAK @ 3135

# 4 3240 TO 3120 PEAK @ 3220



INJECTED @ 3343 @ 11:17  
BOTTOM DETECTOR @ 3350  
UPPER DETECTOR @ 3337.5'  
RECORDED ON TIME DRIVE FOR 10 MINUTES

11:17

11:18

11:19

11:20

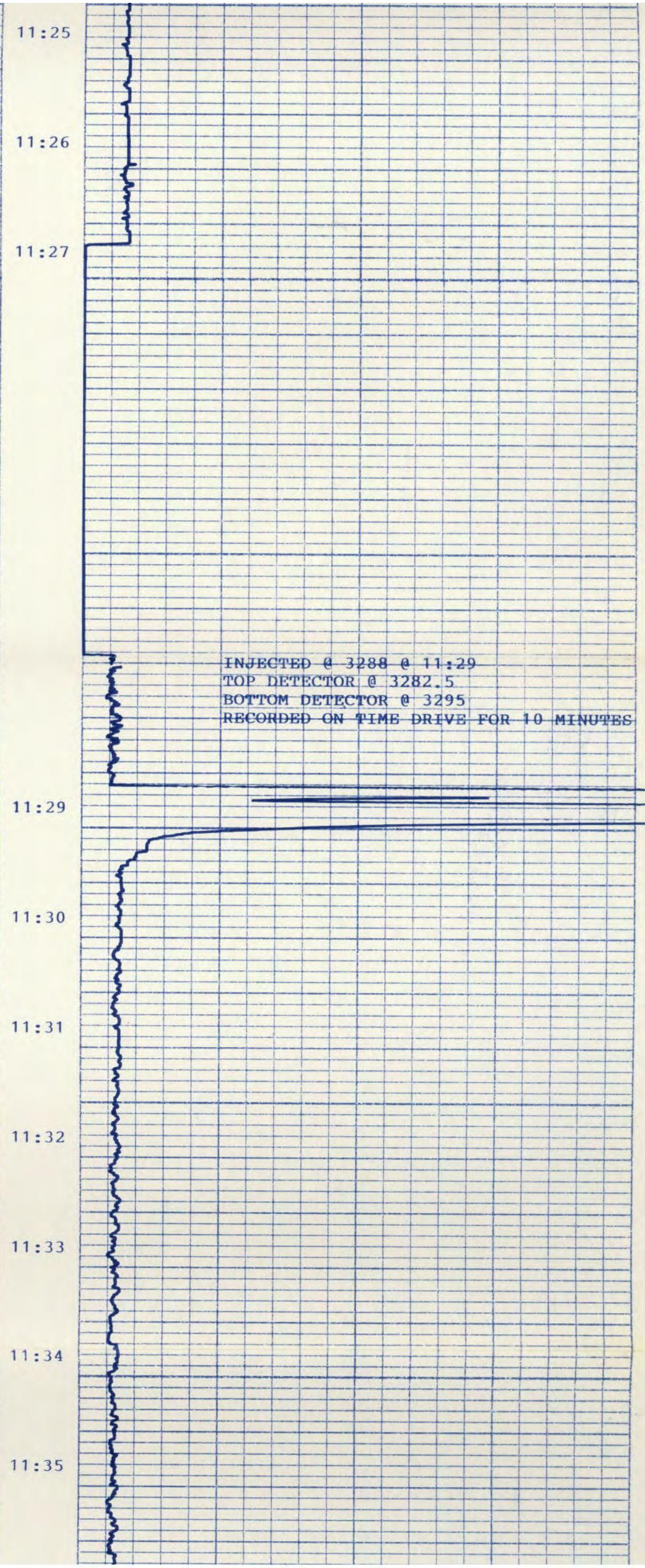
11:21

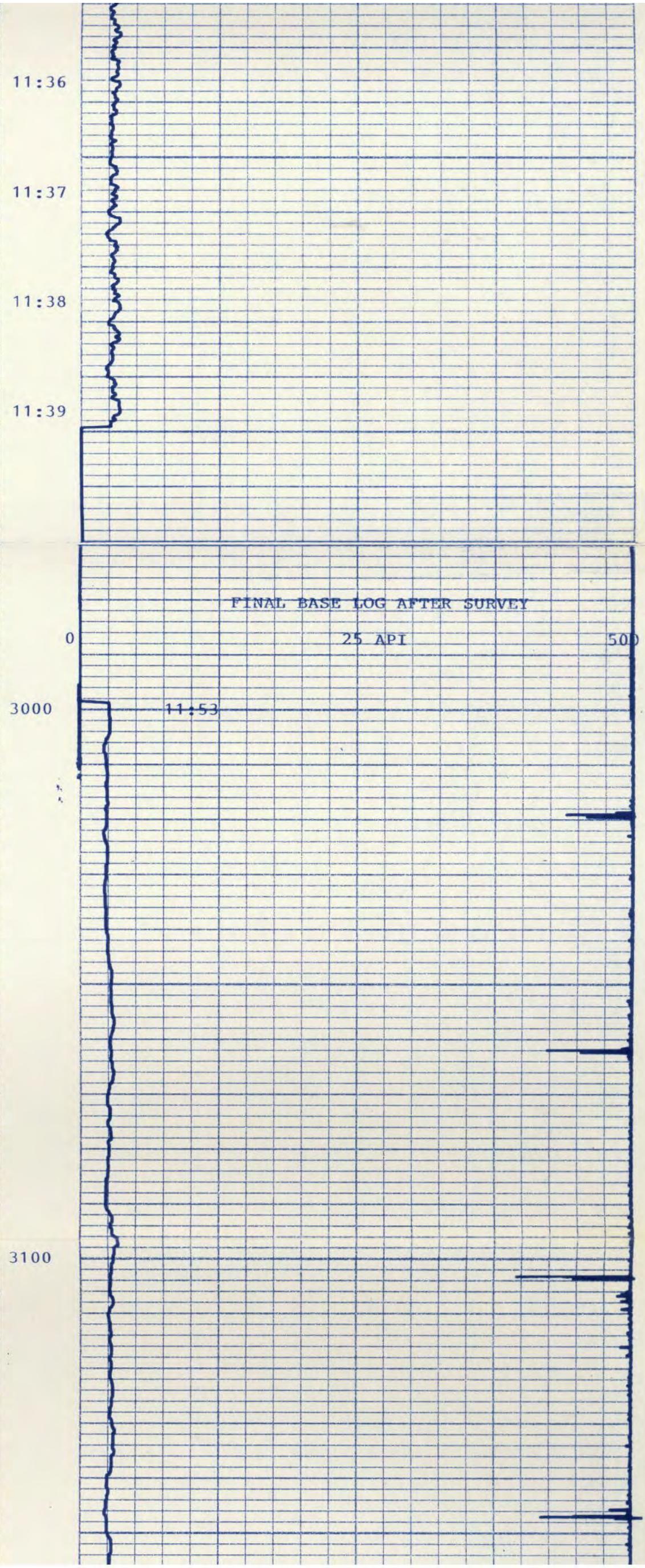
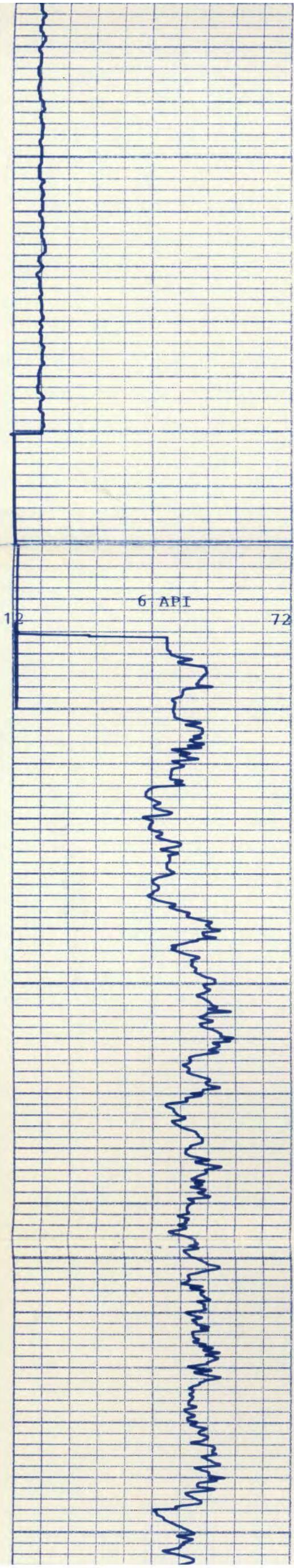
11:22

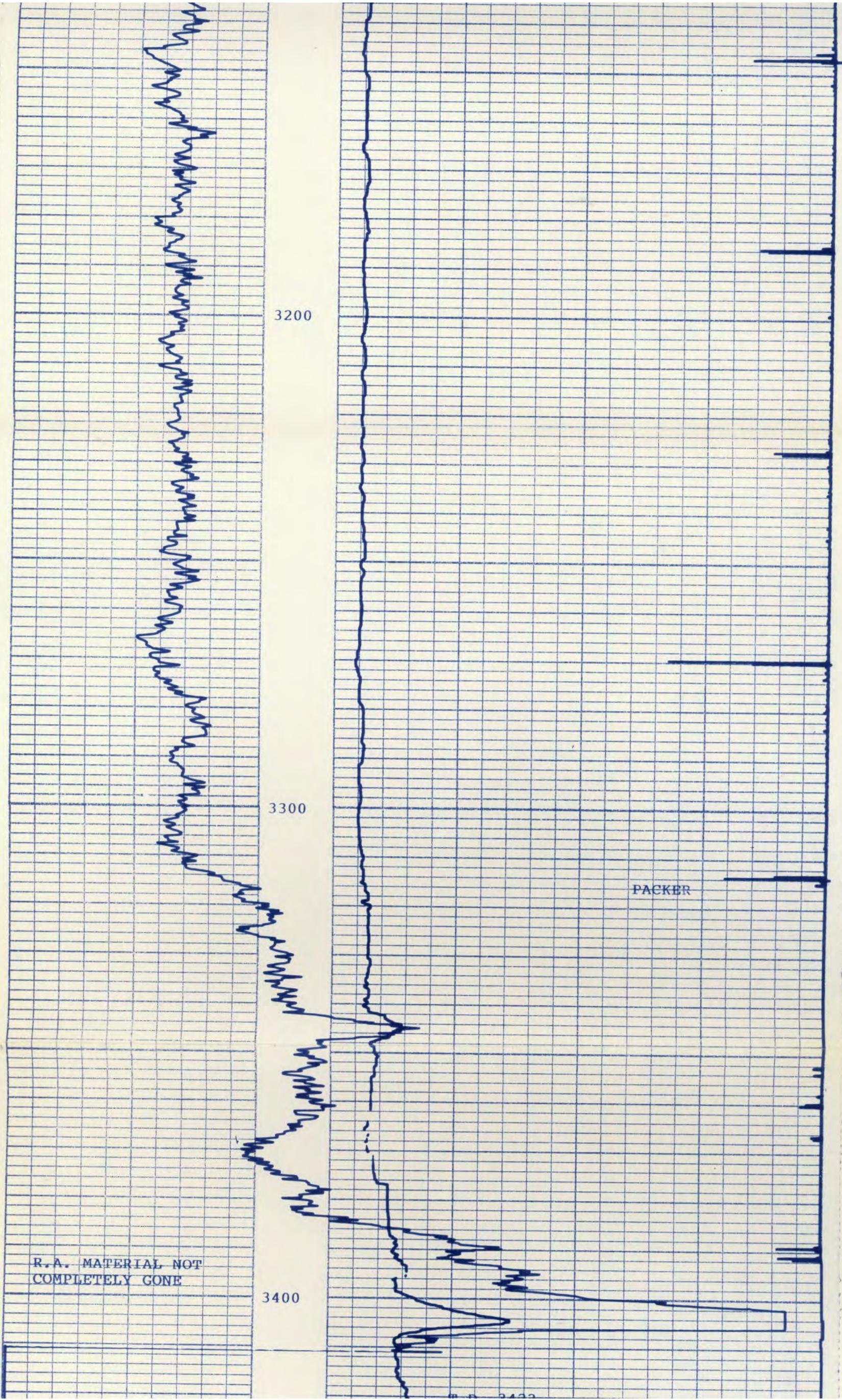
11:23

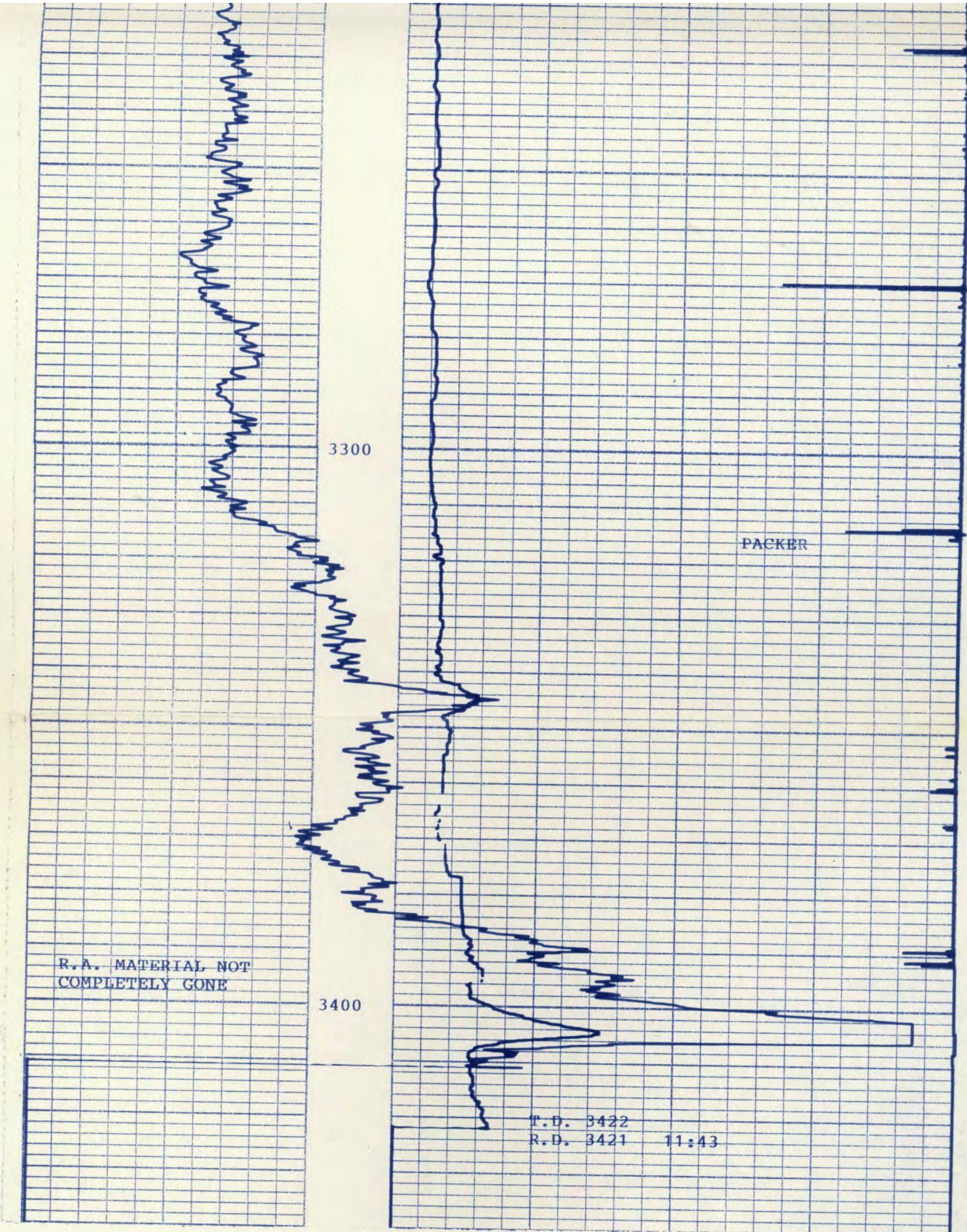
11:24

11:25









**APPENDIX C.1.e**

**GULF COAST'S LOG INTERPRETATION LETTER**



APPENDIX C.2  
WELL SCHEMATIC DRAWING



APPENDIX D  
WASTE DISPOSAL WELL 110



APPENDIX D.1  
MECHANICAL INTEGRITY FIELD TEST DATA



APPENDIX D.1.a  
ANNULUS PRESSURE DATA



Annulus Pressure Data  
Hoechst Celanese Chemical Group, Inc.  
Bay City Plant  
Waste Disposal Well 110  
October 31, 1989

<u>Time</u> (am)	<u>Casing Pressure</u> (psig)	<u>Remarks</u>
8:43	212.0	Well shut-in 20-3/4 hours.
8:44	300.0	Start pressurizing annulus.
8:50	500.0	
8:58	725.0	
9:01	750.0	Start APT.
9:05	750.0	
9:10	749.0	
9:15	749.0	
9:20	748.0	
9:25	748.0	
9:30	748.0	
9:35	748.0	
9:40	748.0	
9:45	749.0	
9:50	749.0	
9:55	749.0	
10:00	749.0	
10:01	749.0	End of APT.
10:06	600.0	Bleeding off pressure.
10:10	220.0	Bled off pressure.

Results: The pressure leak-off was 1 psi (750 to 749 psig) during the 60 minute test period, or 0.1 of 1% leak-off rate. Maximum allowable leak-off is 5% per 60 minutes for this particular well.

Pressure was measured using a 3-D Instruments, Inc. Test Gauge, 0 to 1,500 psi gauge, Serial No. 8807007, 4-1/2" dial face with 10 psi increment and equipped with a reflective glass backing. The gauge was calibrated against pressure standard Mansfield and Green, Drawing No. 2633, on October 5, 1989.

Also, used HCCG's well test transmitter pressure recorder with range 0 - 1,000 psi calibrated to a dead weight tester traceable to National Bureau of Standard on October 20, 1989 by W.H. Heller (See Appendix A.1.b).



No. 54-100

PRINTED IN U.S.A.

1

0—10—20—30—40—50—60—70—80—90—100

TEST START 8:42 AM

APT of XDW-110 11/14

0-1000 P.M.

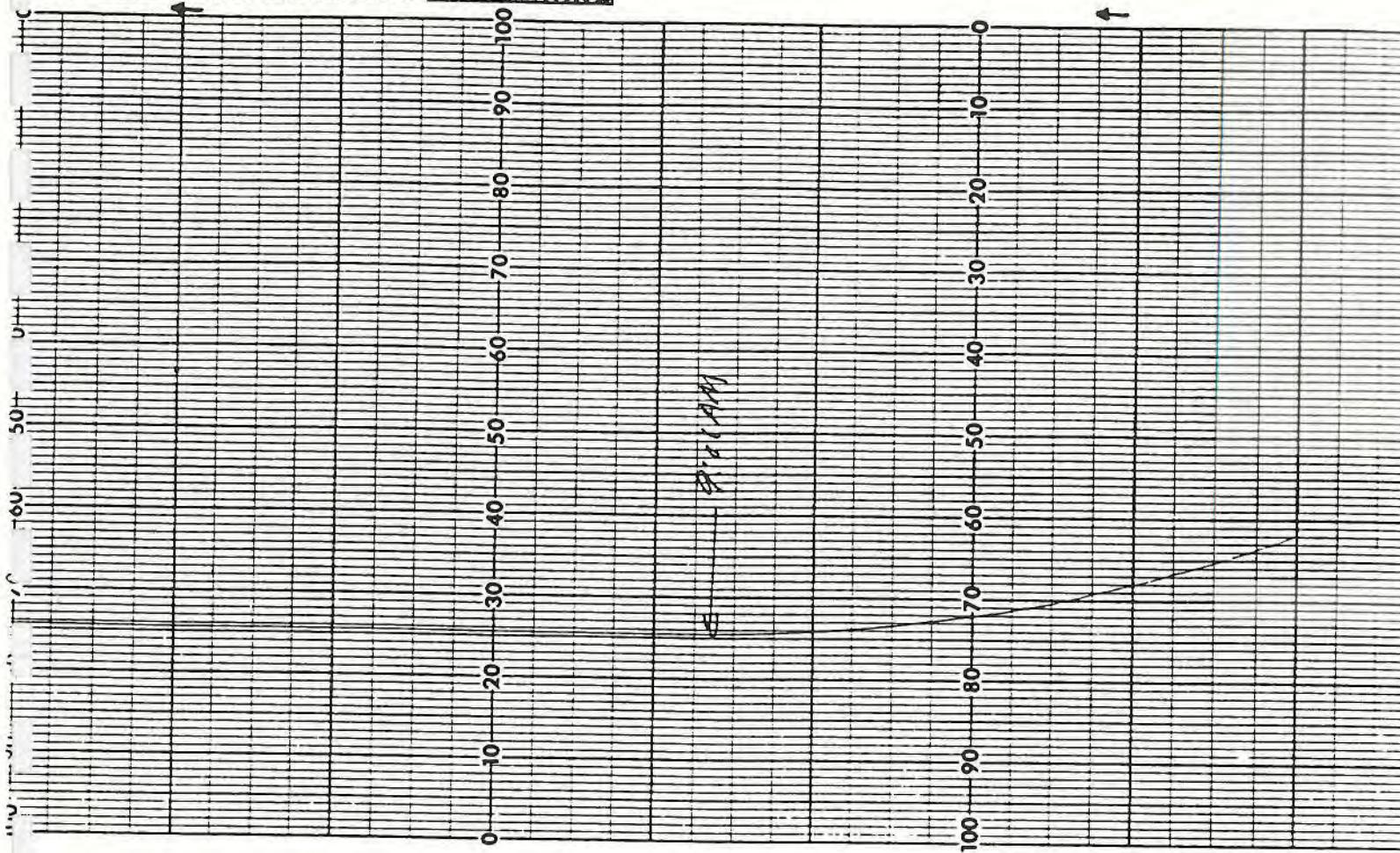
114 X-10

16-50 7940

100—90—80—70—60—50—40—30—20—10

RECHARGING CAPACITY GRAPHIC CONTROL CORPORATION BUFFALO, NEW YORK

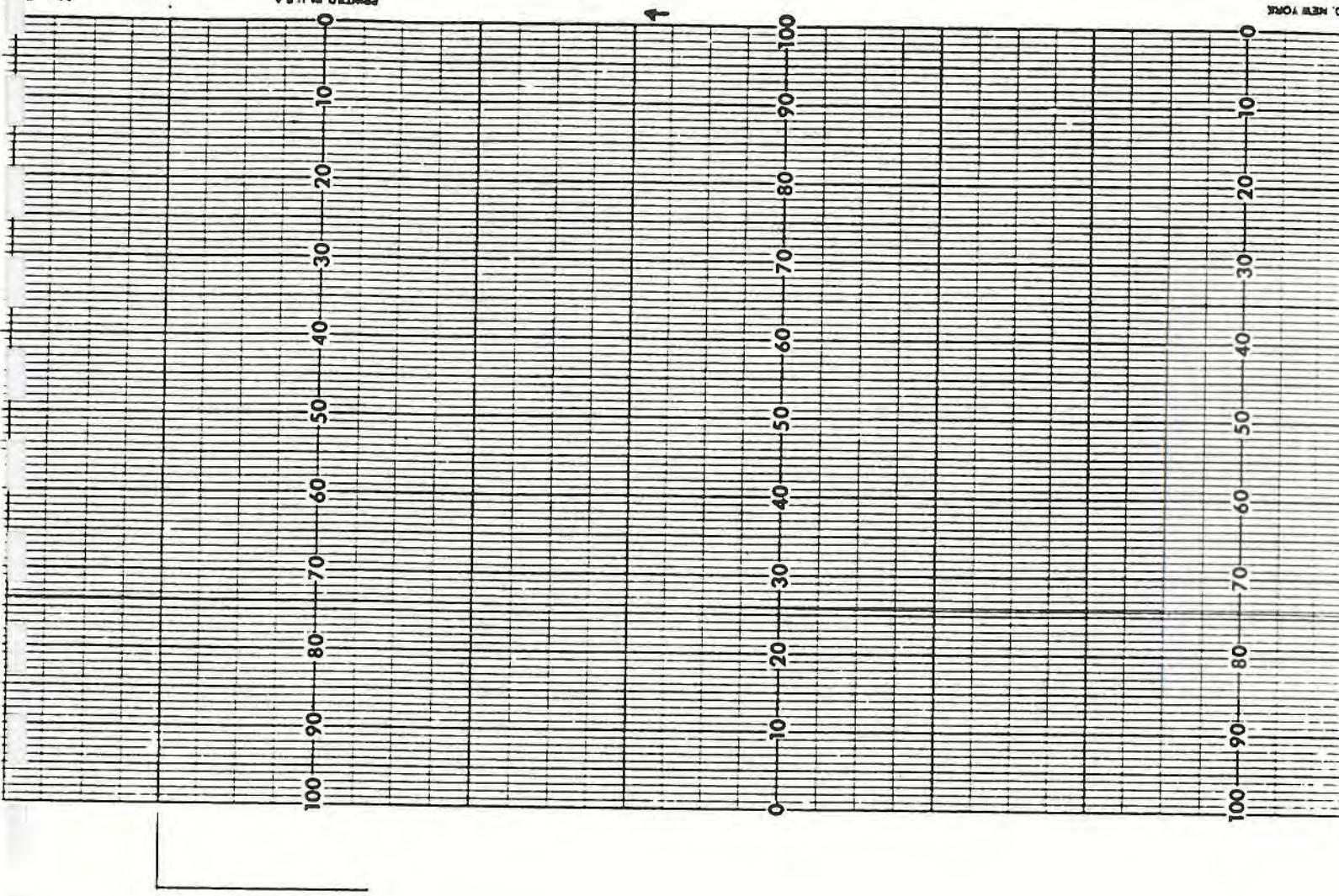
2

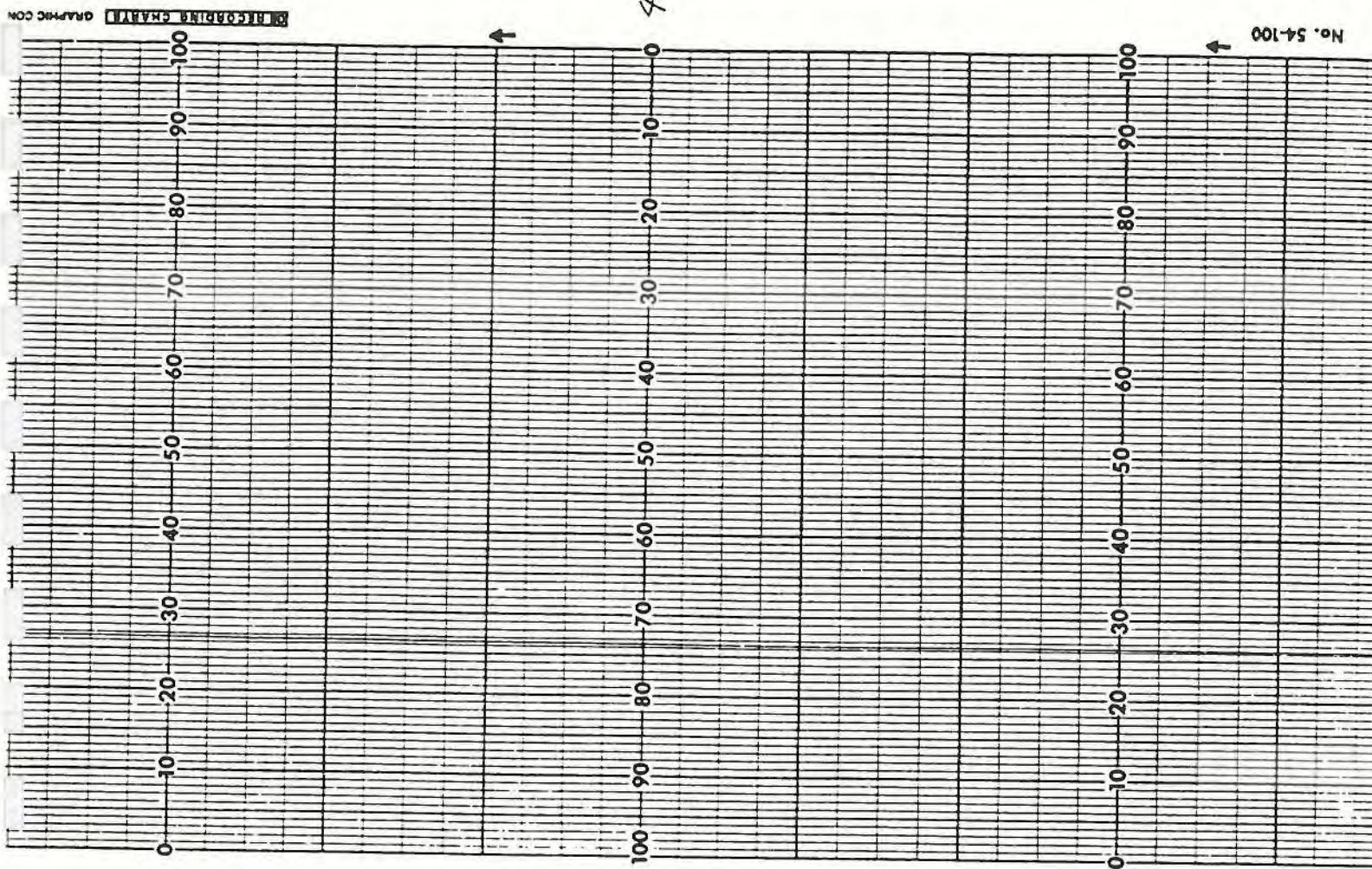


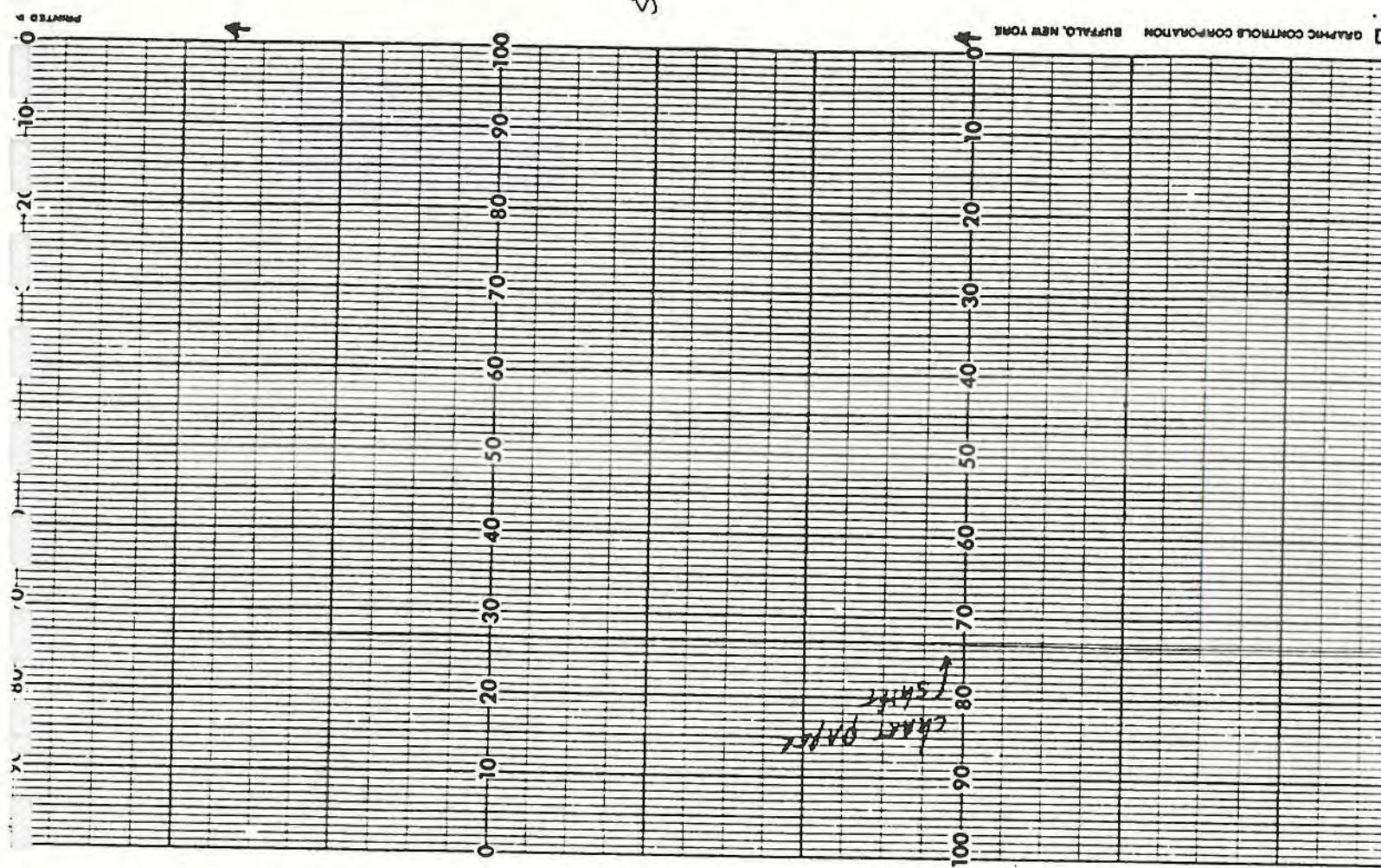
No. 5

PROMPTO RUSCA

3



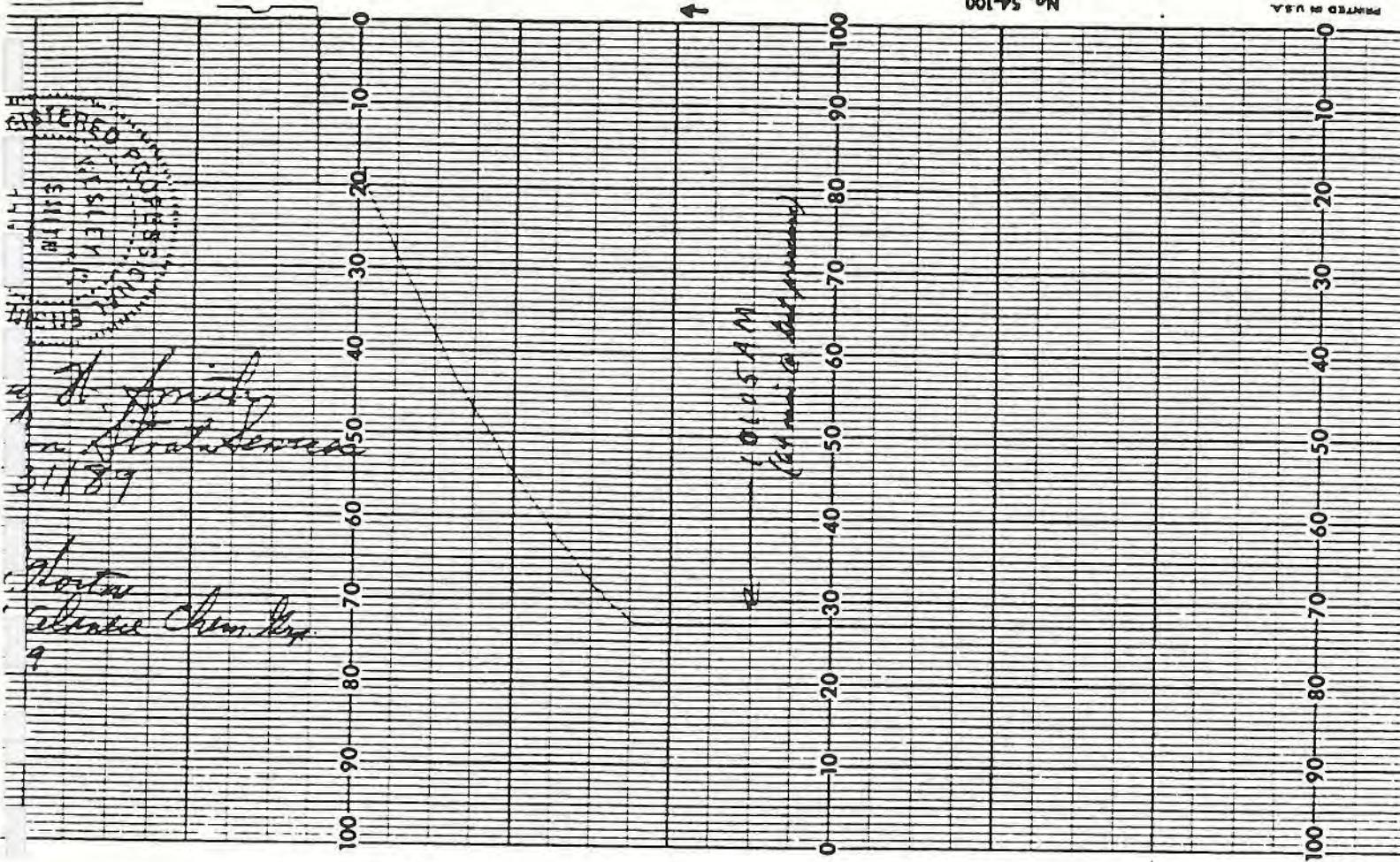


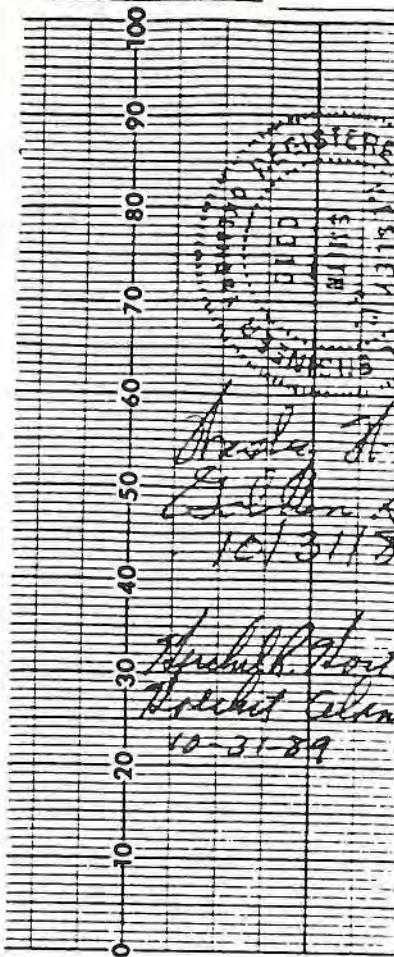


No. 54-100

6

4





APPENDIX D.1.b  
RADIOACTIVE TRACER SURVEY DATA



Radioactive Tracer Survey Data  
 Hoechst Celanese - Chemical Group  
 Bay City Plant  
 Waste Disposal Well 110  
 October 31, 1989

- A. First Base G/R Log: 5662' to 4700' (10:46 am to 11:04 am)
- B. Second Base G/R Log: 5050' to 4700' (11:08 am to 11:16 am)  
 (Ran to confirm repeatability of tool)
- C. Five (5) minute statistical check with tool stationary at depth of 5635' (11:27 am to 11:32 am) and 5025' (11:38 am to 11:43 am)
- D. First Radioactive Slug Ejection. The following RAT data and injection rate reflects the downward movement of the injected fluid.

Pass No.	Time		Depth(Ft.)		Top Slug Depth (Ft.)		Remarks
	From (am/pm)	To (am/pm)	From	To			
1	11:53:15		4700				Eject R/A slug(2 sec.)
1	11:53:38	11:54:35	4750	4700	4735		Injection rate-40 gpm
2	11:55:25	11:57:30	4850	4710	4832		
3	11:59:05	12:02:45	5050	4820	5032		
4	12:05:20	12:05:52	5400	5020	5382		
5	12:13:52	12:18:35	5662	5350	?(*)		End of RAT Survey.

\* - Missed last R/A slug. Slug moved down below PBTD (@5663') and into the disposal interval.

- E. Second R/A Slug Ejection (First Stationary Time Sequence:

Time (pm)	Tool Depth (Ft.)	Remarks
12:28:22	5025	Released R/A slug (2 Sec.). Left tool stationary and turned on time-drive recorder. Pump rate - 120 gpm
12:28:26	5025	Recorded R/A slug peak. Started test.
12:58:26	5025	Survey stopped. R/A slug displaced into disposal interval.

Note: See attached Estimated Time to Run Stationary RAT Sequence  
 (See Appendix D.l.c).



F. Third R/A slug ejection: (Second Stationary Time Sequence):

<u>Time (pm)</u>	<u>Tool Depth (Ft.)</u>	<u>Remarks</u>
1:03:46	5625	Released R/A slug (2 Sec.). Left tool stationary and turned on time-drive recorder. Pump rate - 120 gpm
1:03:50	5625	Recorded R/A slug peak. Started test.
1:08:50	5625	Survey stopped. R/A slug displaced into disposal interval.

G. Final base log: 5662' to 4700' (1:13 pm to 1:30 pm)



APPENDIX D.1.C

ESTIMATED TIME TO RUN STATIONARY RAT SEQUENCE  
(Waste Disposal Well 110)



APPENDIX D.1.d  
RADIOACTIVE TRACER SURVEY



Gulf Coast Well Analysis

RADIOACTIVE TRACER LOG

MECHANICAL INTEGRITY TEST

**NOTICE:** All interpretations are opinions based on inferences from electrical or other measurements and we cannot, and do not, guarantee the accuracy or correctness of any interpretations, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages or expenses incurred or sustained by anyone resulting from any interpretation made by one of our officers, agents or employees. These interpretations are also subject to our General Terms and Conditions as set out in our current Price Schedule.

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**EQUIPMENT DATA**

EQUIPMENT DATA					
Gamma Ray			Neutron		
Run No.	ONE		Run No.		
Tool Model No.	CRC		Log Type		
Diameter	1.43		Tool Model No.		
Detector Model No.	G-1		Diameter		
Type	GEIGER		Detector Model No.		
Length	12"		Type		
Distance to N. Source			Length		
General			Source Model No.		
Hoist Truck No.	101		Serial No.		
Instrument Truck No.	101		Spacing		
Tool Serial No.	1234-35		Type		
District	PEARLAND		Strength		

## **LOGGING DATA**

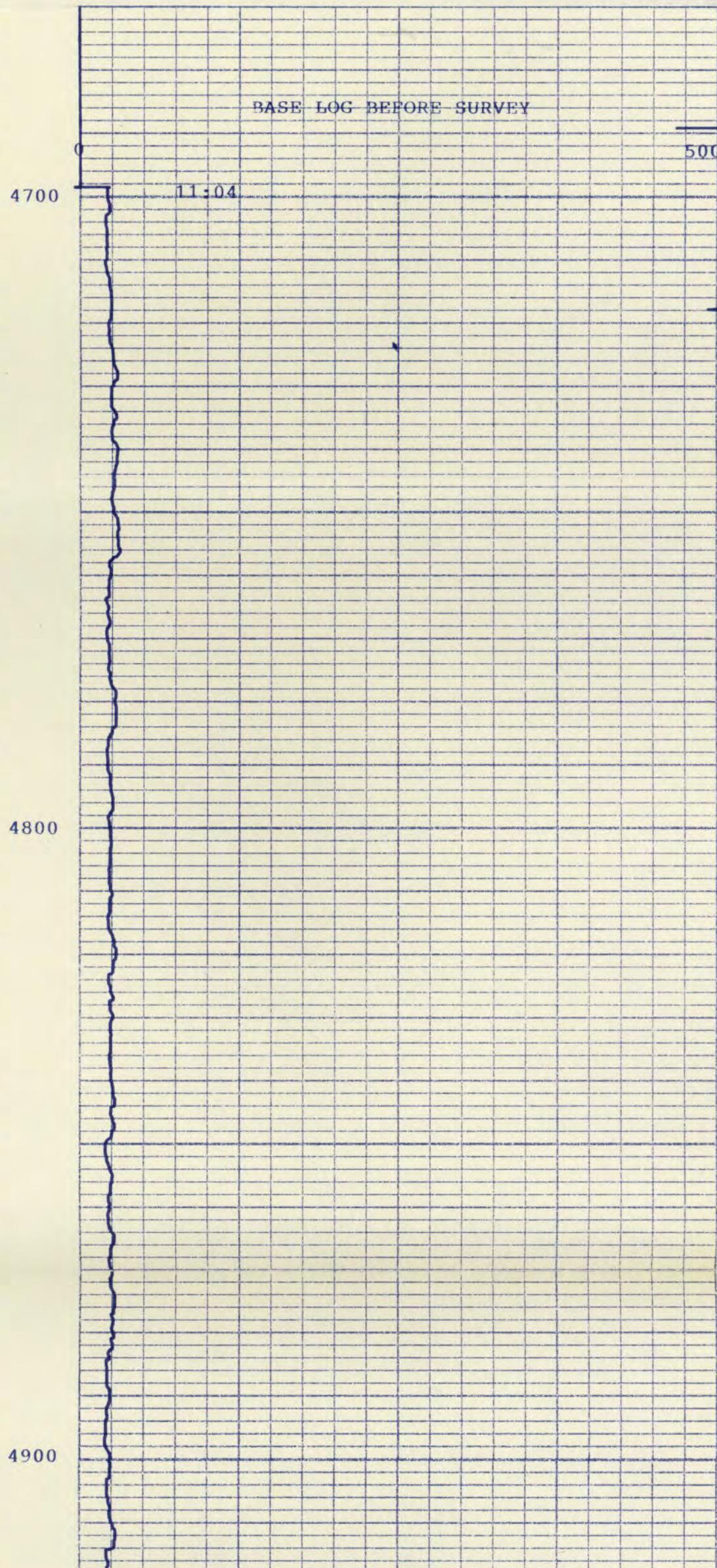
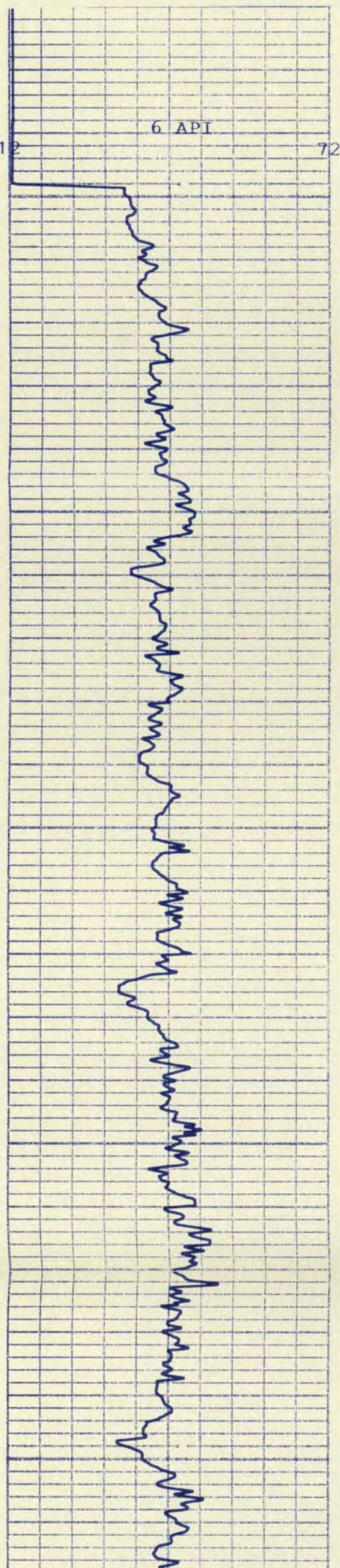
Reference Literature: TOP DETECTOR TO CCL = 3 FT.  
CCL TO INJECTOR = 2 FT.  
INJECTOR TO BOTTOM DETECTOR = 7.5 FT.  
TOP DETECTOR TO BOTTOM DETECTOR = 12.5 FT.

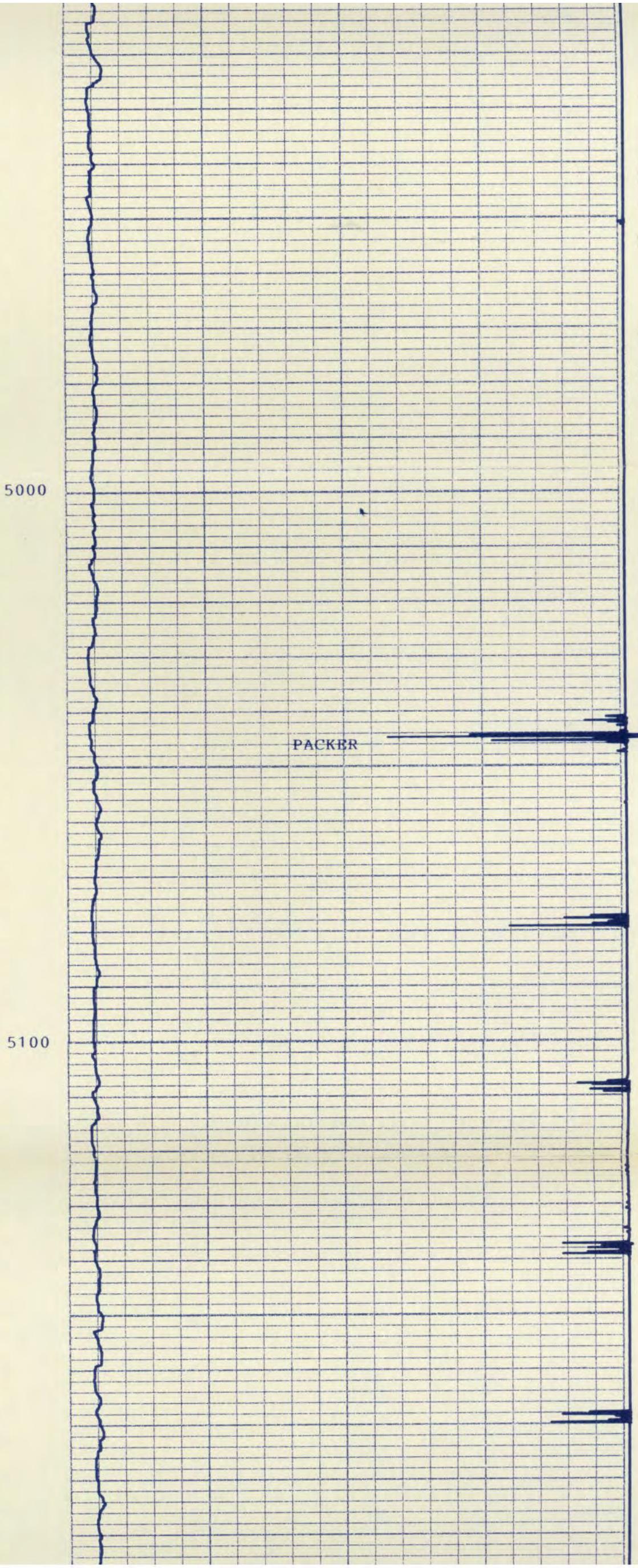
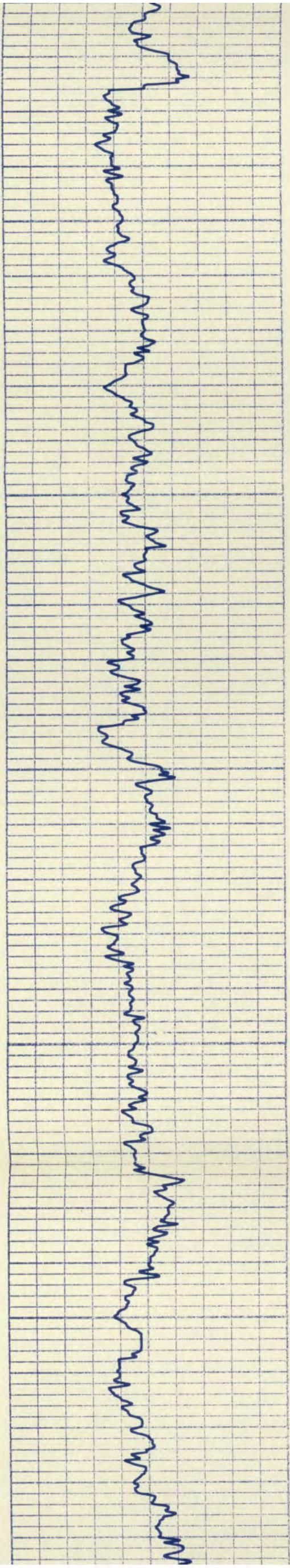
Remarks: RADIOACTIVE TRACER LOG INDICATES THAT ALL FLUID IS GOING BELOW 5662 AT THIS TIME. NO INDICATION OF FLUID MIGRATION UP HOLE OR PACKER LEAKING.

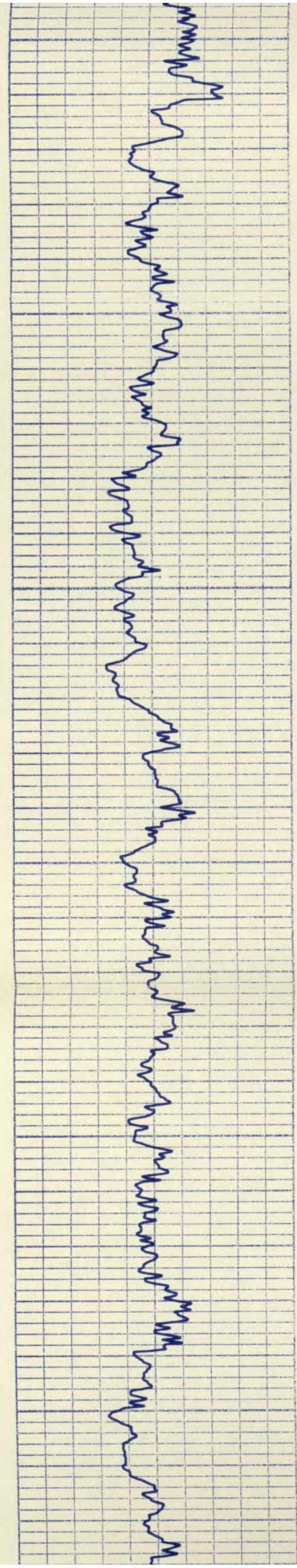
Fold Here

NEUTRON

GAMMA RAY	DEPTHS	NEUTRON
API GAMMA-RAY UNITS		API NEUTRON UNITS



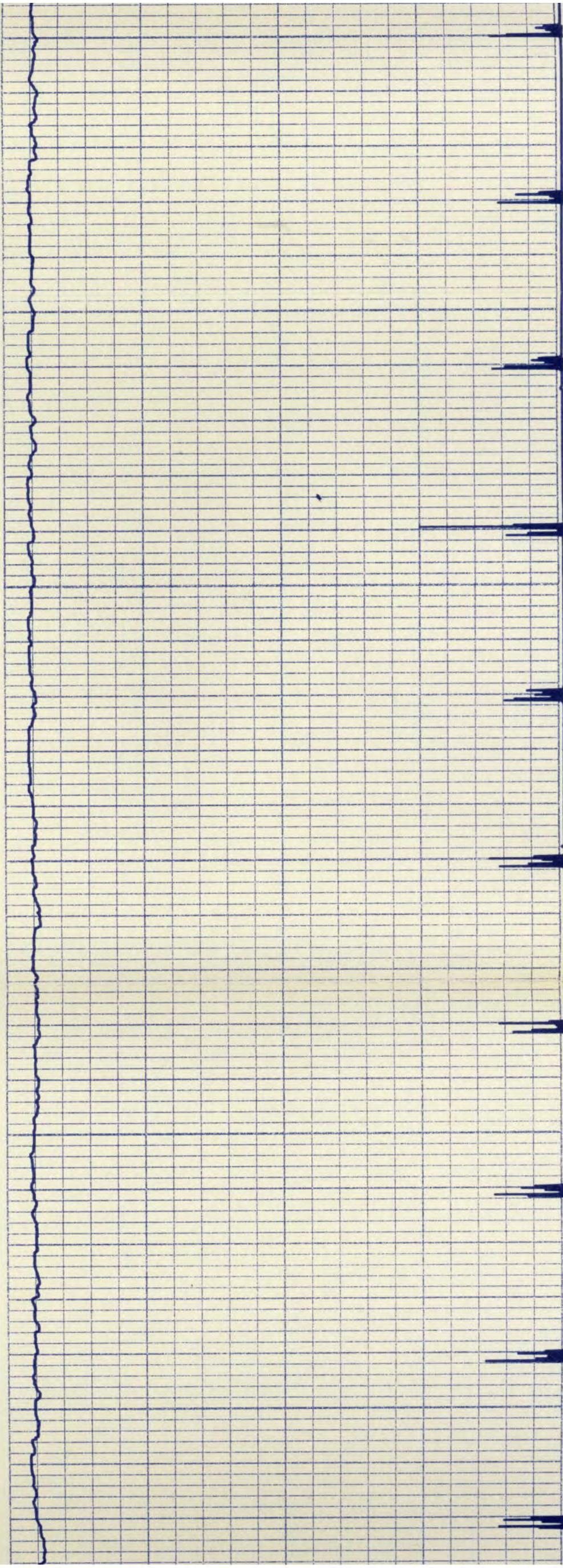


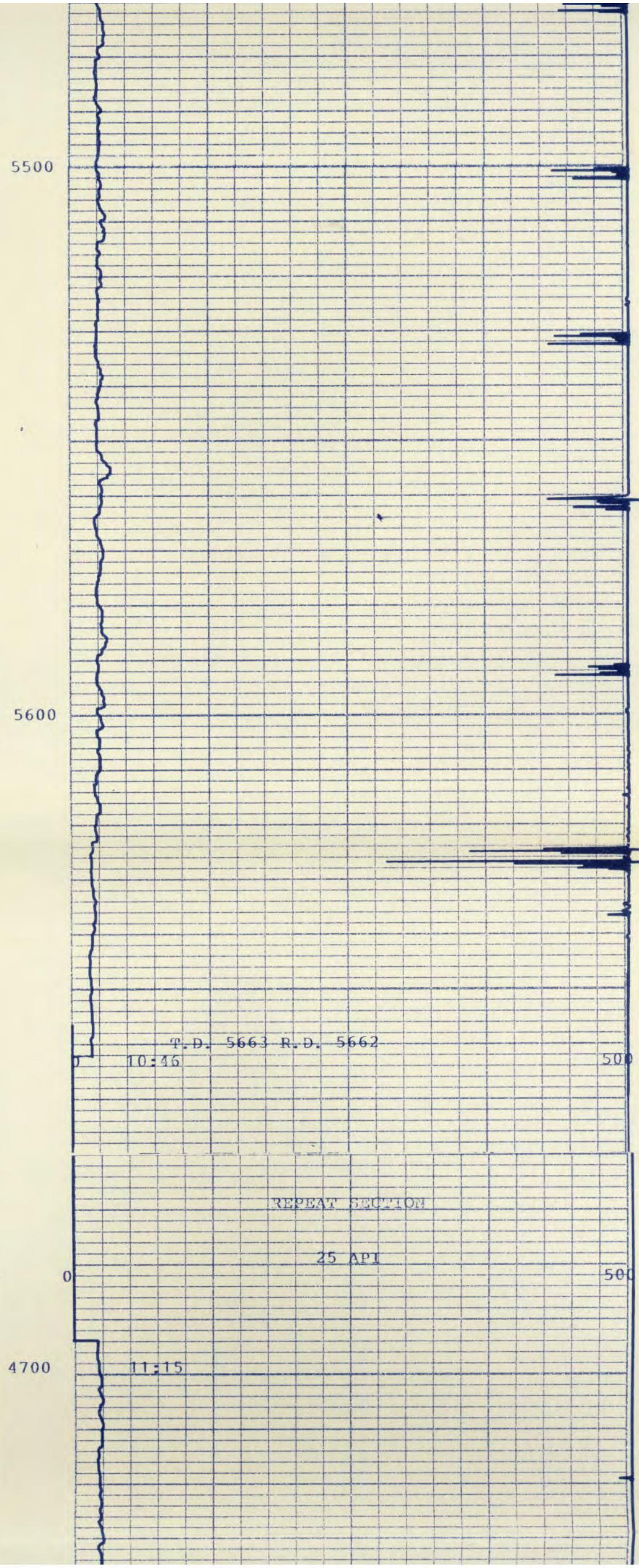
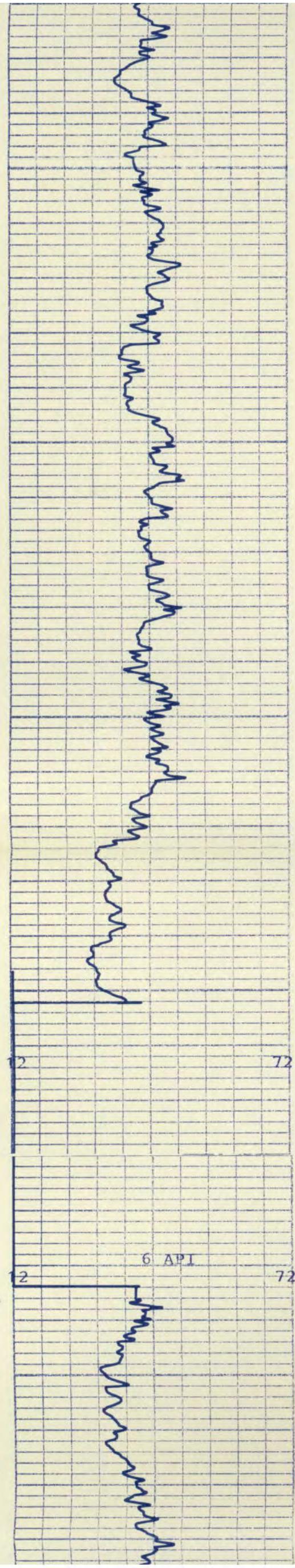


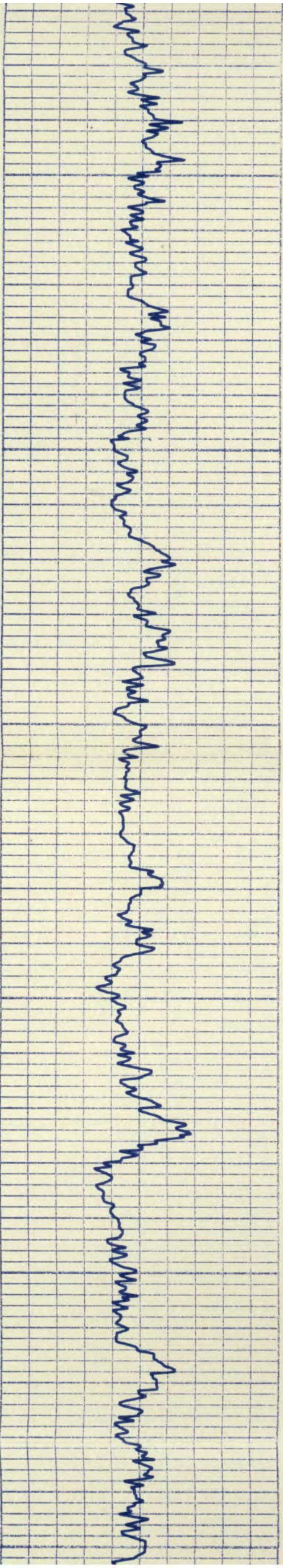
5200

5300

5400



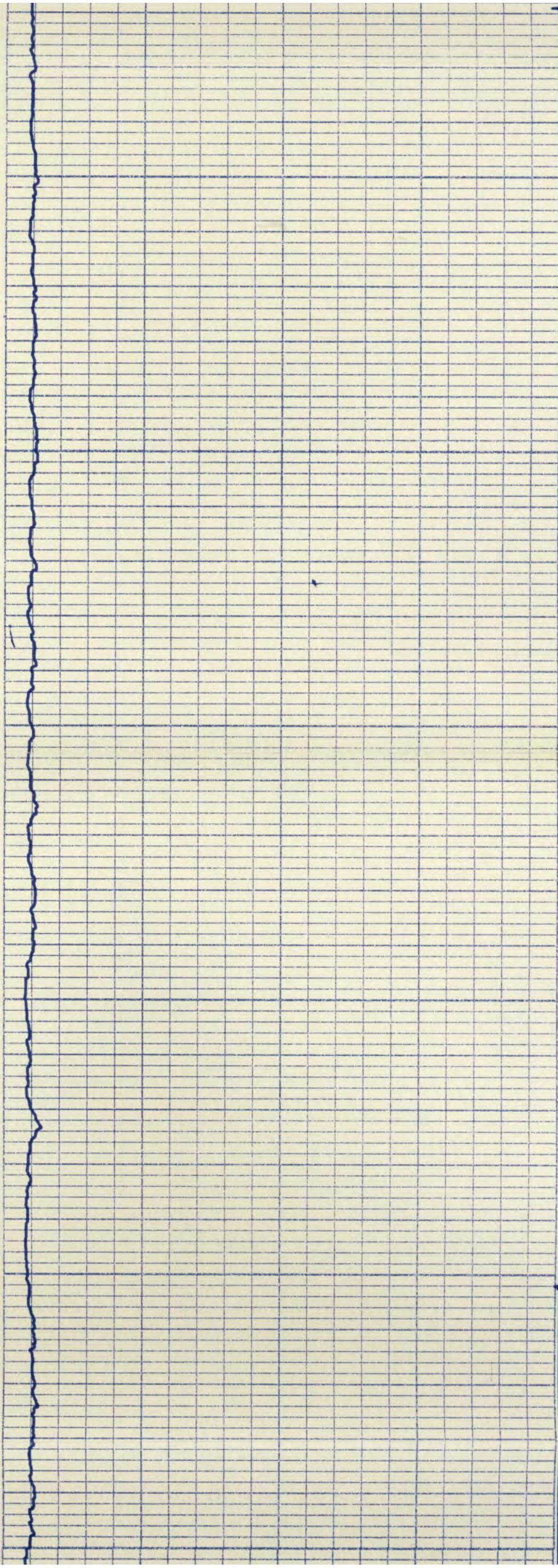


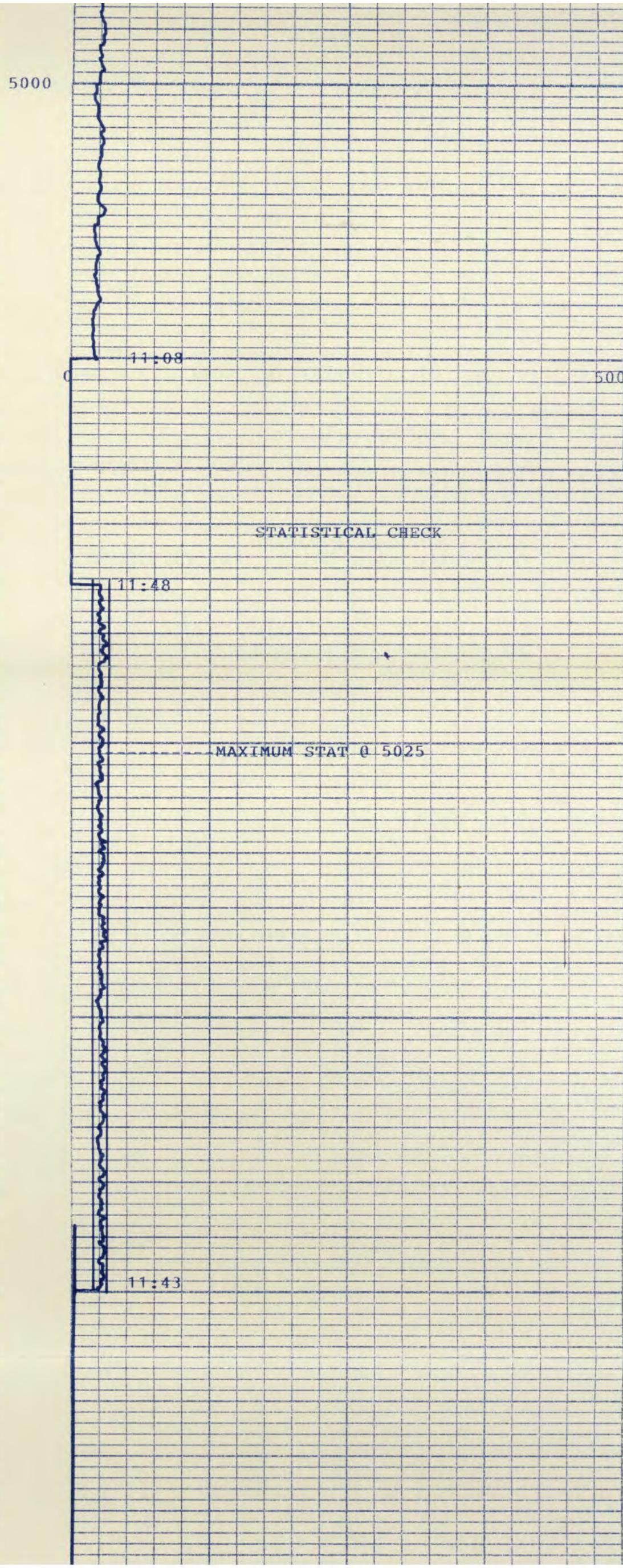
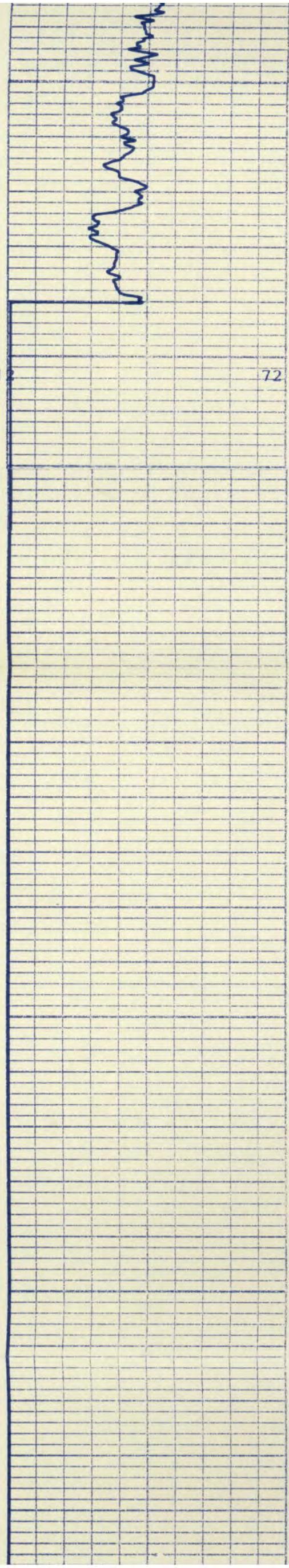


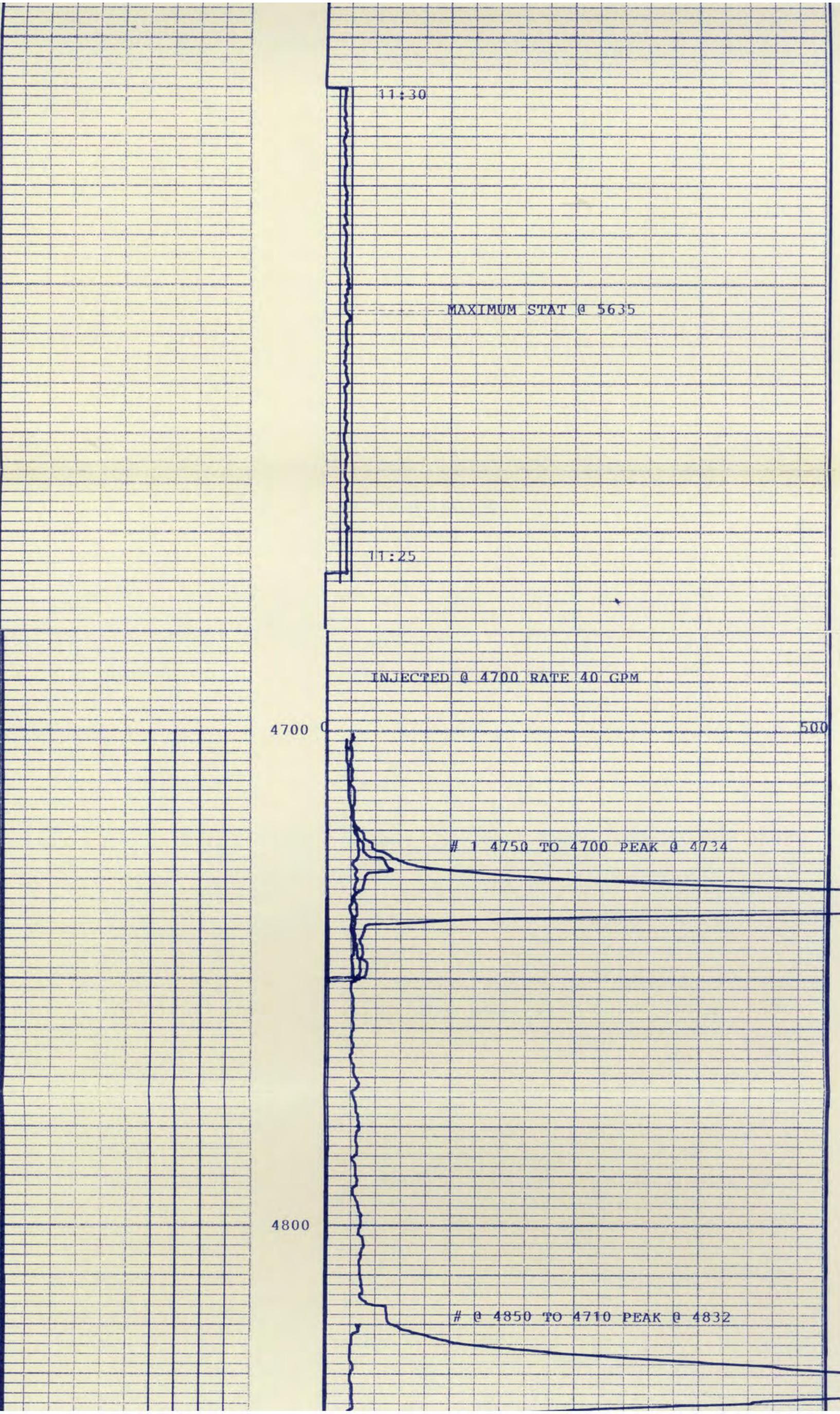
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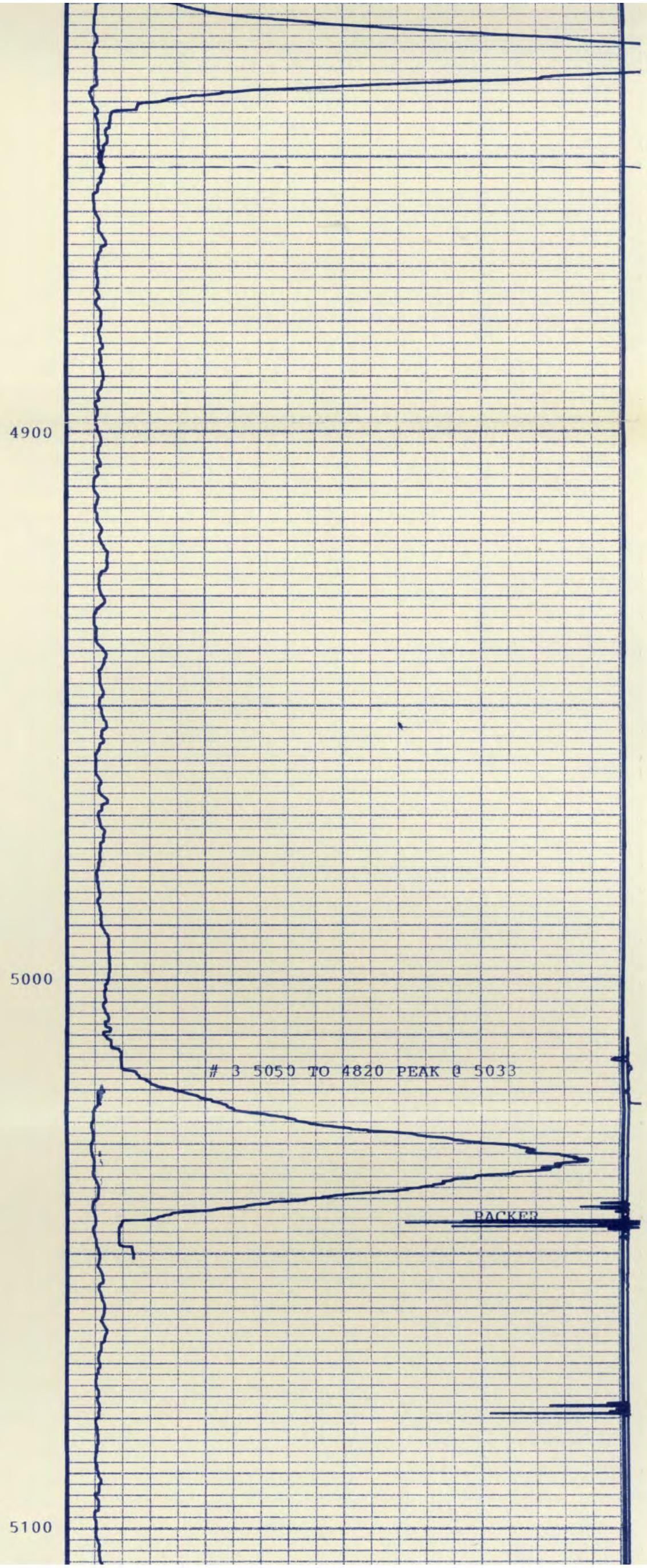
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5000







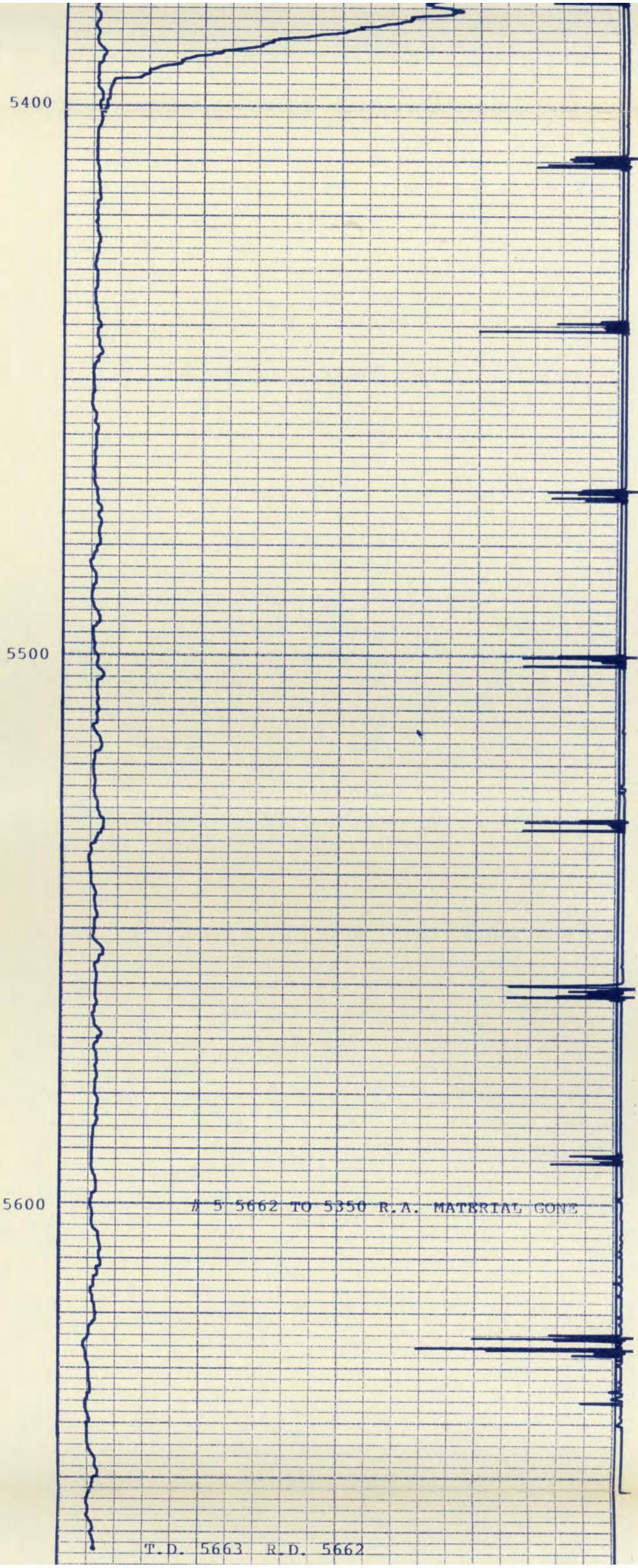


5100

5200

5300

# 4 5400 TO 5020 PEAK @ 5382



T.D. 5663 R.D. 5662

INJECTED @ 5018  
BOTTOM DETECTOR @ 5025  
TOP DETECTOR @ 5012.5  
R.A. MATERIAL PASSED BOTTOM DETECTOR  
RECORDED ON TIME DRIVE FOR 30 MINUTES

5 MINUTES

10 MINUTES

15 MINUTES

20 MINUTES

25 MINUTES

30 MINUTES

INJECTED @ 5628  
BOTTOM DETECTOR @ 5635  
TOP DETECTOR @ 5622.5  
R. A. MATERIAL PASSED BOTTOM DETECTOR  
RECORDED ON TIME DRIVE FOR 5 MINUTES

1 MINUTE

2 MINUTES

3 MINUTES

4 MINUTES

5 MINUTES

6 MINUTES

6 MINUTES

6 API

12 72



BASE LOG AFTER SURVEY

25 API

0 500

4700 13:30

4800

4900

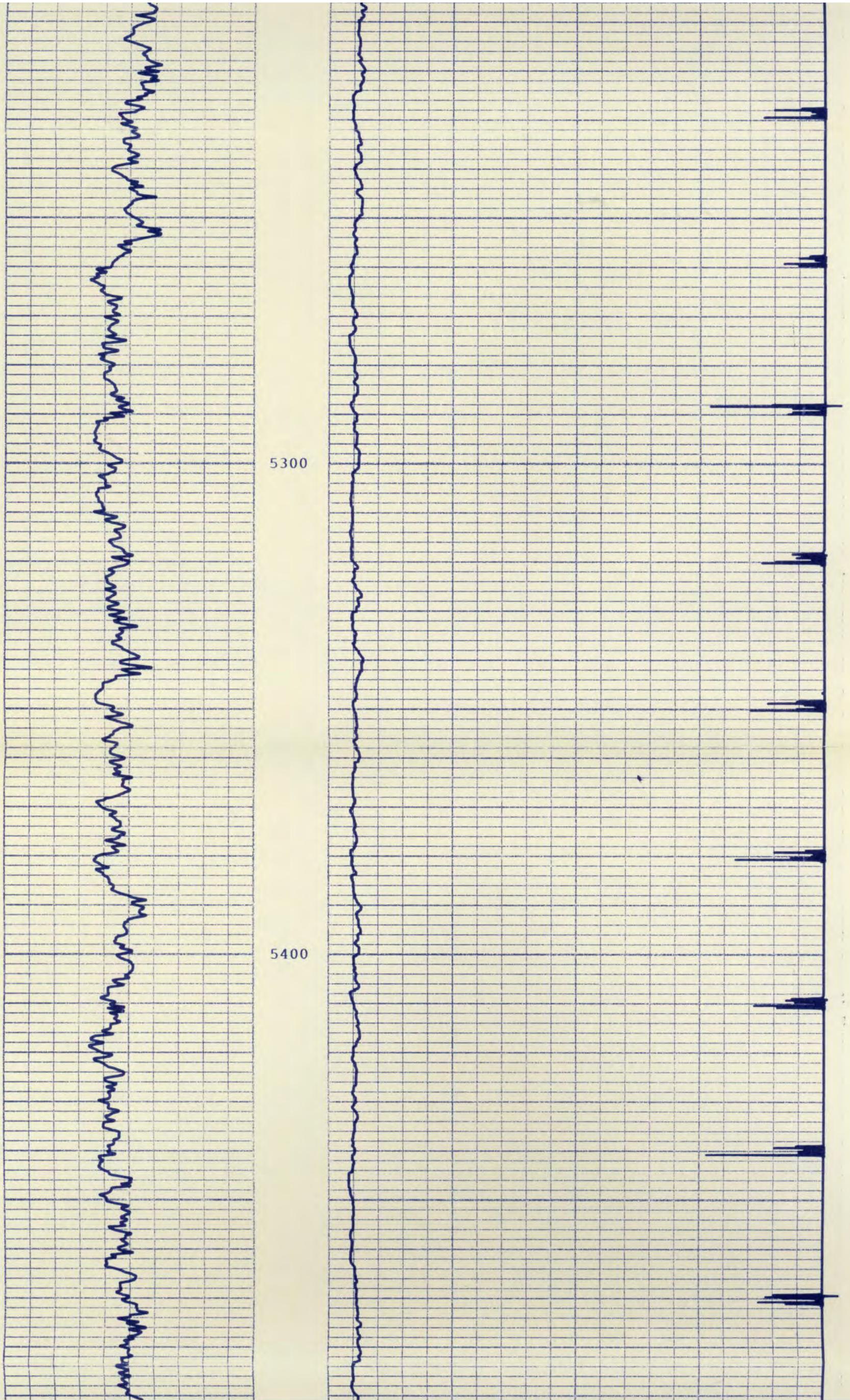


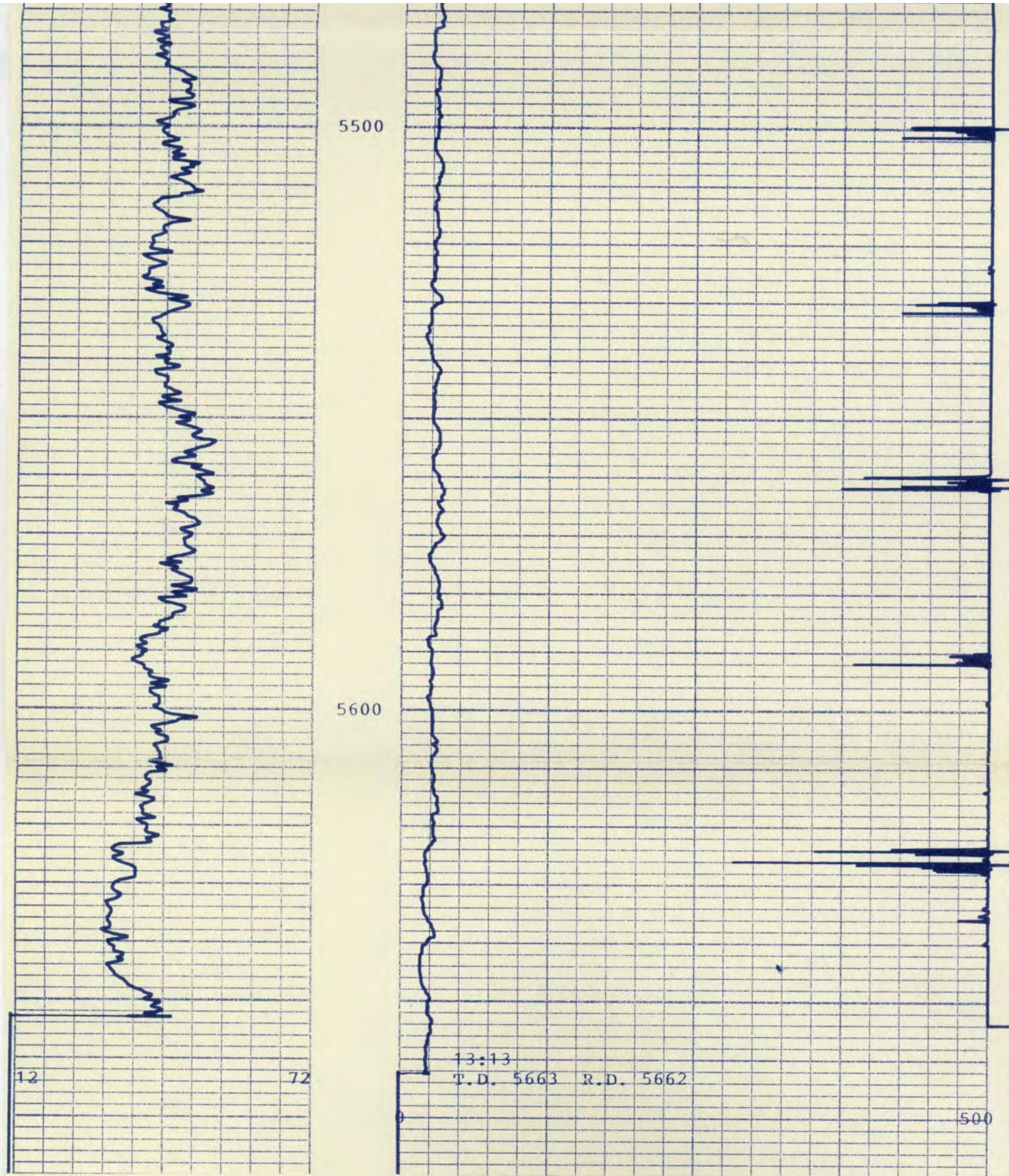
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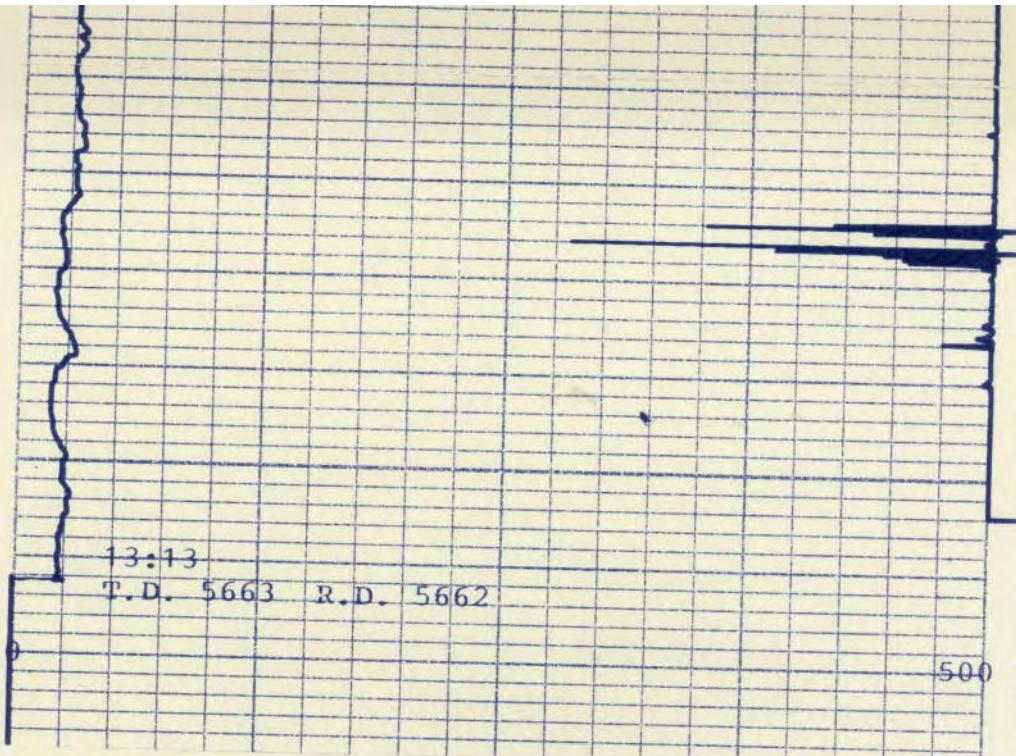
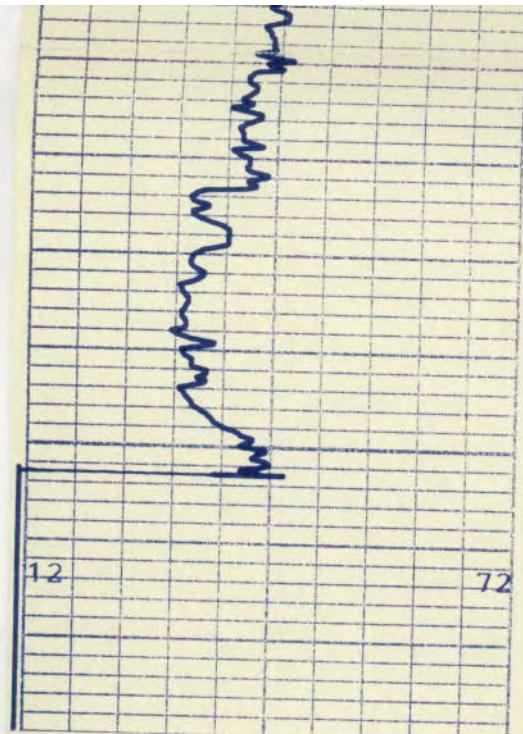
PACKER

5100

5200







**APPENDIX D.1.e**

**GULF COAST'S LOG INTERPRETATION LETTER**



APPENDIX D.2  
FALL-OFF & STATIC BOTTOM HOLE PRESSURE DATA



## GULF COAST WELL ANALYSIS

ELECTRIC WIRELINE SERVICE COMPANY  
P.O. BOX 2308  
PEARLAND, TEXAS 77588  
(713) 485-6548

COMPANY		DATE
HOECHST CELANESE		OCTOBER 30, 1989
WELL		FIELD
WDW 110 # 1-A		BAY CITY PLANT
FORMATION		COUNTY AND STATE
5600'		MATAGORDA, TEXAS
SURFACE LOCATION		SUB-SURFACE LOCATION
KELLY BUSHING ELEVATION	DRILLER'S FLOOR ELEVATION	GROUND LEVEL ELEVATION
17'	15'	N.A.
PERMNET DATUM	PERMANENT DATUM ELEVATION	DRILLING MEASURED FROM
GROUND LEVEL	N.A.	KELLY BUSHING
LOG MEASURED FROM	G.C.W.A. TOUCH DOWN	CUSTOMER PLUGBACK
KELLY BUSHING	N.A.	N.A.
HP GAGUE SERIAL #	TEMP TOOL SERIAL #	G.C.W.A. UNIT #
9-0004	9-0004	101
GCWA ENGINEER	CUSTOMER ENGINEER	OTHER SERVICE COMPANY
JOHNSON & ROOD	MR. WES SMITH	NONE

### TABLE OF CONTENTS (ITEMS ARE LISTED IN THEIR ORDER OF INSERTION)

#### SECTION I

TABULATED DATA & PLOTS OF FALL-OFF TEST

#### SECTION II

TABULATED DATA & PLOTS OF STATIC GRADIENT SURVEY

#### SECTION III

RADIOACTIVE TRACER LOG ( MACHANICAL INTEGRITY TEST )

#### SECTION IV

CALIBRATION CERTIFICATES OF PANEX PRESSURE TRANSDUCERS  
# 9-0004 & 2-1070

**GULF COAST WELL ANALYSIS**  
**STATIC GRADIENT SURVEY**

COMPANY HOECHST CELANESE LEASE/WELL # MDW 110 # 1-A			DATE OCTOBER 30, 1989 FIELD BAY CITY PLANT		
DEPTH (FEET)	OBSERVED TEMPERATURES IN DEGREES FAHRENHEIT	TEMP. GRADIENTS IN DEGREES F/100 FEET	OBSERVED PRESSURES AT DEPTH IN PRESSURE PER SQUARE INCH	PRESSURE GRADIENTS PSI PER FOOT	MIN/ STOP
17   17	87.00	.18	113,970	.473	5
500   500	103.20	.35	342,420	.443	5
1000   1000	104.10	.18	563,700	.435	5
1500   1500	107.10	.60	781,080	.434	5
2000   2000	109.90	.56	997,850	.431	5
2500   2500	112.40	.50	1213,290	.443	5
3000   3000	115.40	.60	1434,970	.415	5
3500   3500	120.90	1.10	1642,550	.448	5
4000   4000	120.50	-.08	1866,590	.434	5
4500   4500	123.60	.62	2083,630	.428	5
5000   5000	127.30	.74	2297,490	.405	5
5500   5500	128.80	.30	2499,930	.527	5
5640   5640	121.70	-5.07	2573,720		

**GULF COAST WELL ANALYSIS**  
**FALL-OFF TEST**

FINAL REPORT

PAGE 0001

COMPANY				LEASE/WELL				DATE			
HOECHST CELANESE				MDW 110 # 1-A				MONDAY -- OCTOBER 30, 1989			
FIELD				MEASURED AND TRUE VERTICAL TOOL DEPTHS				MID-PERF TVD AND GRADIENT			
BAY CITY PLANT				5640 FEET -- 5640 FEET				5640 FEET -- .44 PSI/FOOT			
DISC &	REAL TIME DATA	BH		BOTTOM HOLE PRESSURE				SURFACE INFORMATION			
SAMPLE	TIME	dTIME	TEMP.	PRESSURE	DELTA PRESSURE IN PSI	(8)	TUBING	MDW152	MHT		
NUMBER	HH:MM:SS	IN HOURS	(F)	IN PSI	P(o)	P (n-1)	SLOPE	IN PSI	IN PSI	DEGREES F	
1- 92	11:50:40	0.0000	110.70	2641.070	0.000	2641.070		1.000	1.00	1.00	
1- 93	11:50:50	.0028	110.60	2626.680	-14.390	-14.390		1.000	1.00	1.00	
1- 94	11:51:00	.0056	110.50	2610.550	-30.520	-16.130		1.000	1.00	1.00	
1- 95	11:51:10	.0083	110.40	2605.110	-35.960	-5.440		1.000	1.00	1.00	
1- 96	11:51:20	.0111	110.40	2602.500	-38.570	-2.610		1.000	1.00	1.00	
1- 97	11:51:40	.0167	110.30	2598.390	-42.680	-4.110		1.000	1.00	1.00	
1- 98	11:51:50	.0194	110.20	2596.500	-44.570	-1.890		1.000	1.00	1.00	
1- 99	11:52:00	.0222	110.10	2595.160	-45.910	-1.340		1.000	1.00	1.00	
1- 100	11:52:10	.0250	110.10	2594.390	-46.680	-.770		1.000	1.00	1.00	
1- 101	11:52:20	.0278	110.00	2593.400	-47.670	-.990		1.000	1.00	1.00	
1- 102	11:52:30	.0306	110.00	2592.590	-48.480	-.810		1.000	1.00	1.00	
1- 103	11:52:40	.0333	110.00	2591.660	-49.410	-.930		1.000	1.00	1.00	
1- 104	11:52:50	.0361	110.00	2591.220	-49.850	-.440		1.000	1.00	1.00	
1- 105	11:53:00	.0389	110.00	2590.240	-50.830	-.980		1.000	1.00	1.00	
1- 106	11:53:10	.0417	109.90	2589.590	-51.480	-.650		1.000	1.00	1.00	
1- 107	11:53:20	.0444	109.90	2588.940	-52.130	-.650		1.000	1.00	1.00	
1- 108	11:53:30	.0472	109.90	2588.410	-52.660	-.530		1.000	1.00	1.00	
1- 109	11:53:40	.0500	109.90	2588.010	-53.060	-.400		1.000	1.00	1.00	
1- 110	11:53:50	.0528	109.90	2587.170	-53.900	-.840		1.000	1.00	1.00	
1- 111	11:54:00	.0556	109.90	2586.760	-54.310	-.410		1.000	1.00	1.00	
1- 112	11:54:10	.0583	109.90	2586.130	-54.940	-.630		1.000	1.00	1.00	
1- 113	11:54:20	.0611	109.90	2585.730	-55.340	-.400		1.000	1.00	1.00	
1- 114	11:54:30	.0639	110.00	2585.110	-55.960	-.620		1.000	1.00	1.00	
1- 115	11:54:40	.0667	110.00	2584.370	-56.700	-.740		1.000	1.00	1.00	
1- 116	11:54:50	.0694	110.00	2583.900	-57.170	-.470		1.000	1.00	1.00	
1- 117	11:55:00	.0722	110.00	2583.710	-57.360	-.190		1.000	1.00	1.00	
1- 118	11:55:10	.0750	110.00	2583.260	-57.810	-.450	-315.306	1.000	1.00	1.00	
1- 119	11:55:20	.0778	110.00	2582.810	-58.260	-.450	-276.078	1.000	1.00	1.00	
1- 120	11:55:30	.0806	110.00	2582.350	-58.720	-.460	-249.988	1.000	1.00	1.00	
1- 121	11:55:40	.0833	110.10	2581.770	-59.300	-.580	-228.578	1.000	1.00	1.00	
1- 122	11:55:50	.0861	110.10	2581.520	-59.550	-.250	-215.911	1.000	1.00	1.00	
1- 123	11:56:00	.0889	110.20	2580.890	-60.180	-.630	-207.471	1.000	1.00	1.00	
1- 124	11:56:10	.0917	110.20	2580.450	-60.420	-.240	-200.329	1.000	1.00	1.00	
1- 125	11:56:20	.0944	110.20	2580.130	-60.940	-.520	-193.669	1.000	1.00	1.00	
1- 126	11:56:30	.0972	110.30	2580.050	-61.020	-.080	-186.890	1.000	1.00	1.00	
1- 127	11:56:40	.1000	110.30	2579.120	-61.950	-.930	-182.420	1.000	1.00	1.00	
1- 128	11:56:50	.1028	110.40	2579.020	-62.050	-.100	-177.901	1.000	1.00	1.00	
1- 129	11:57:00	.1056	110.40	2578.540	-62.530	-.480	-173.060	1.000	1.00	1.00	
1- 130	11:57:10	.1083	110.50	2578.210	-62.860	-.330	-169.333	1.000	1.00	1.00	
1- 131	11:57:20	.1111	110.50	2578.070	-63.000	-.140	-165.079	1.000	1.00	1.00	
1- 132	11:57:30	.1139	110.60	2578.010	-63.060	-.060	-160.175	1.000	1.00	1.00	
1- 133	11:57:40	.1167	110.60	2577.330	-63.740	-.680	-156.412	1.000	1.00	1.00	
1- 134	11:57:50	.1194	110.70	2577.200	-63.870	-.130	-151.452	1.000	1.00	1.00	
1- 135	11:58:00	.1222	110.70	2577.110	-63.960	-.090	-146.822	1.000	1.00	1.00	
1- 136	11:58:10	.1250	110.70	2576.840	-64.230	-.270	-141.779	1.000	1.00	1.00	
1- 137	11:58:20	.1278	110.80	2576.660	-64.410	-.180	-136.855	1.000	1.00	1.00	
1- 138	11:58:30	.1306	110.80	2576.370	-64.700	-.290	-131.713	1.000	1.00	1.00	
1- 139	11:58:40	.1333	110.80	2576.250	-64.820	-.120	-126.609	1.000	1.00	1.00	
1- 140	11:58:50	.1361	110.90	2576.120	-64.950	-.130	-122.148	1.000	1.00	1.00	
1- 141	11:59:00	.1389	110.90	2575.880	-65.190	-.240	-117.892	1.000	1.00	1.00	

\* SLOPE DEFINITION:DELTA TIME vs. PRESSURE

**GULF COAST WELL ANALYSIS**  
**FALL-OFF TEST**

FINAL REPORT

PAGE 0002

COMPANY				LEASE/WELL				DATE			
HOECHST CELANESE				WDW 110 # 1-A				MONDAY -- OCTOBER 30, 1989			
FIELD				MEASURED AND TRUE VERTICAL TOOL DEPTHS				MID-PERF TVD AND GRADIENT			
BAY CITY PLANT				5640 FEET -- 5640 FEET				5640 FEET -- .44 PSI/FDT			
DISC & 3	REAL TIME DATA	BH		BOTTOM HOLE PRESSURE				SURFACE INFORMATION			
SAMPLE	TIME	dTIME	TEMP.	PRESSURE	DELTA PRESSURE IN PSI	(t)	TUBING	WDW152	WHT		
NUMBER	HH:MM:SS	IN HOURS	(F)	IN PSI	P(g)	P (n-1)	SLOPE	IN PSI	IN PSI	DEGREES F	
1- 142	11:59:10	.1417	111.00	2575.760	-65.310	-.120	-112.497	1.000	1.00	1.00	
1- 143	11:59:20	.1444	111.00	2575.630	-65.440	-.130	-106.953	1.000	1.00	1.00	
1- 144	11:59:30	.1472	111.00	2575.490	-65.580	-.140	-101.382	1.000	1.00	1.00	
1- 145	11:59:40	.1500	111.10	2575.370	-65.700	-.120	-95.838	1.000	1.00	1.00	
1- 146	11:59:50	.1528	111.10	2575.180	-65.890	-.190	-91.080	1.000	1.00	1.00	
1- 147	12:00:00	.1556	111.20	2575.020	-66.050	-.160	-85.929	1.000	1.00	1.00	
1- 148	12:00:10	.1583	111.20	2574.860	-66.210	-.160	-81.778	1.000	1.00	1.00	
1- 149	12:00:20	.1611	111.20	2574.760	-66.310	-.100	-77.154	1.000	1.00	1.00	
1- 150	12:00:30	.1639	111.30	2574.550	-66.520	-.210	-73.468	1.000	1.00	1.00	
1- 151	12:00:50	.1694	111.40	2574.530	-66.540	-.020	-67.827	1.000	1.00	1.00	
1- 152	12:01:00	.1722	111.40	2574.480	-66.590	-.050	-64.321	1.000	1.00	1.00	
1- 153	12:01:10	.1750	111.50	2574.260	-66.810	-.220	-60.797	1.000	1.00	1.00	
1- 154	12:01:20	.1778	111.50	2574.190	-66.880	-.070	-58.003	1.000	1.00	1.00	
1- 155	12:01:30	.1806	111.60	2574.140	-66.930	-.050	-55.442	1.000	1.00	1.00	
1- 156	12:01:40	.1833	111.60	2574.010	-67.060	-.130	-52.794	1.000	1.00	1.00	
1- 157	12:01:50	.1861	111.70	2573.920	-67.150	-.090	-49.658	1.000	1.00	1.00	
1- 158	12:02:00	.1889	111.70	2573.770	-67.300	-.150	-48.277	1.000	1.00	1.00	
1- 159	12:02:10	.1917	111.80	2573.590	-67.480	-.180	-47.025	1.000	1.00	1.00	
1- 160	12:02:20	.1944	111.80	2573.520	-67.550	-.070	-45.405	1.000	1.00	1.00	
1- 161	12:02:30	.1972	111.90	2573.510	-67.560	-.010	-43.832	1.000	1.00	1.00	
1- 162	12:02:40	.2000	111.90	2573.420	-67.650	-.090	-42.316	1.000	1.00	1.00	
1- 163	12:02:50	.2028	111.90	2573.360	-67.710	-.060	-41.151	1.000	1.00	1.00	
1- 164	12:03:00	.2056	112.00	2573.180	-67.890	-.180	-40.195	1.000	1.00	1.00	
1- 165	12:03:10	.2083	112.00	2573.140	-67.930	-.040	-39.032	1.000	1.00	1.00	
1- 166	12:03:20	.2111	112.10	2573.010	-68.060	-.130	-38.329	1.000	1.00	1.00	
1- 167	12:03:30	.2139	112.10	2573.090	-67.980	.080	-37.065	1.000	1.00	1.00	
1- 168	12:03:40	.2167	112.10	2573.070	-68.000	-.020	-35.622	1.000	1.00	1.00	
1- 169	12:03:50	.2194	112.20	2573.030	-68.040	-.040	-34.120	1.000	1.00	1.00	
1- 170	12:04:00	.2222	112.20	2573.000	-68.070	-.030	-32.477	1.000	1.00	1.00	
1- 171	12:04:10	.2250	112.20	2573.050	-68.020	.050	-30.707	1.000	1.00	1.00	
1- 172	12:04:20	.2278	112.30	2573.000	-68.070	-.050	-29.075	1.000	1.00	1.00	
1- 173	12:04:30	.2306	112.30	2572.950	-68.120	-.050	-27.614	1.000	1.00	1.00	
1- 174	12:04:40	.2333	112.30	2572.900	-68.170	-.050	-26.131	1.000	1.00	1.00	
1- 175	12:04:50	.2361	112.30	2572.960	-68.110	.060	-24.693	1.000	1.00	1.00	
1- 176	12:05:00	.2389	112.40	2572.840	-68.230	-.120	-23.062	1.000	1.00	1.00	
1- 177	12:05:10	.2417	112.40	2572.770	-68.300	-.070	-21.376	1.000	1.00	1.00	
1- 178	12:05:20	.2444	112.40	2572.750	-68.320	-.020	-20.074	1.000	1.00	1.00	
1- 179	12:05:30	.2472	112.50	2572.620	-68.450	-.130	-19.038	1.000	1.00	1.00	
1- 180	12:05:40	.2500	112.50	2572.630	-68.440	.010	-17.715	1.000	1.00	1.00	
1- 181	12:05:50	.2528	112.50	2572.660	-68.410	.030	-16.341	1.000	1.00	1.00	
1- 182	12:06:00	.2556	112.60	2572.660	-68.410	0.000	-14.918	1.000	1.00	1.00	
1- 183	12:06:10	.2583	112.60	2572.720	-68.350	.060	-13.486	1.000	1.00	1.00	
1- 184	12:06:20	.2611	112.60	2572.650	-68.420	-.070	-12.644	1.000	1.00	1.00	
1- 185	12:06:30	.2639	112.60	2572.650	-68.420	0.000	-11.794	1.000	1.00	1.00	
1- 186	12:06:40	.2667	112.70	2572.650	-68.420	0.000	-10.739	1.000	1.00	1.00	
1- 187	12:06:50	.2694	112.70	2572.640	-68.430	-.010	-9.803	1.000	1.00	1.00	
1- 188	12:07:00	.2722	112.70	2572.710	-68.360	.070	-8.634	1.000	1.00	1.00	
1- 189	12:07:10	.2750	112.70	2572.700	-68.370	-.010	-7.967	1.000	1.00	1.00	
1- 190	12:07:20	.2778	112.80	2572.750	-68.320	.050	-7.145	1.000	1.00	1.00	
1- 191	12:07:30	.2806	112.80	2572.740	-68.330	-.010	-6.715	1.000	1.00	1.00	

\* SLOPE DEFINITION:DELTA TIME vs. PRESSURE

**GULF COAST WELL ANALYSIS**  
**FALL-OFF TEST**

FINAL REPORT

PAGE 0003

COMPANY		LEASE/WELL				DATE				
HOECHST CELANESE		MDW 110 # 1-A				MONDAY -- OCTOBER 30, 1989				
FIELD		MEASURED AND TRUE VERTICAL TOOL DEPTHS				MID-PERF TVD AND GRADIENT				
BAY CITY PLANT		5640 FEET -- 5640 FEET				5640 FEET -- .44 PSI/FOOT				
DISC &	REAL TIME DATA	BH	BOTTOM HOLE PRESSURE				SURFACE INFORMATION			
SAMPLE	TIME	dTIME	TEMP.	PRESSURE	DELTA PRESSURE IN PSI	( $\Delta$ )	TUBING	MDW152	WT	
NUMBER	HH:MM:SS	IN HOURS	(F)	IN PSI	P(o)	P (n-1)	SLOPE	IN PSI	IN PSI	DEGREES F
1- 192	12:07:40	.2833	112.80	2572.790	-68.280	.050	-5.757	1.000	1.00	1.00
1- 193	12:07:50	.2861	112.80	2572.840	-68.230	.050	-4.622	1.000	1.00	1.00
1- 194	12:08:00	.2889	112.90	2572.840	-68.230	0.000	-3.567	1.000	1.00	1.00
1- 195	12:08:10	.2917	112.90	2572.830	-68.240	-.010	-2.600	1.000	1.00	1.00
1- 196	12:08:20	.2944	112.90	2572.810	-68.260	-.020	-1.473	1.000	1.00	1.00
1- 197	12:08:30	.2972	112.90	2572.750	-68.320	-.060	-0.659	1.000	1.00	1.00
1- 198	12:08:40	.3000	113.00	2572.790	-68.280	.040	.177	1.000	1.00	1.00
1- 199	12:08:50	.3028	113.00	2572.810	-68.260	.020	.944	1.000	1.00	1.00
1- 200	12:09:00	.3056	113.00	2572.780	-68.290	-.030	1.853	1.000	1.00	1.00
1- 201	12:09:10	.3083	113.00	2572.860	-68.210	.080	2.645	1.000	1.00	1.00
1- 202	12:09:20	.3111	113.00	2572.890	-68.180	.030	3.279	1.000	1.00	1.00
1- 203	12:09:30	.3139	113.10	2572.900	-68.170	.010	3.841	1.000	1.00	1.00
1- 204	12:09:40	.3167	113.10	2572.940	-68.130	.040	4.026	1.000	1.00	1.00
1- 205	12:10:00	.3222	113.10	2572.900	-68.170	-.040	3.986	1.000	1.00	1.00
1- 206	12:10:10	.3250	113.10	2572.930	-68.140	-.030	4.083	1.000	1.00	1.00
1- 207	12:10:20	.3278	113.20	2573.070	-68.000	.140	4.581	1.000	1.00	1.00
1- 208	12:10:30	.3306	113.20	2573.010	-68.060	-.060	4.962	1.000	1.00	1.00
1- 209	12:10:40	.3333	113.20	2573.010	-68.060	0.000	5.024	1.000	1.00	1.00
1- 210	12:10:50	.3361	113.20	2573.080	-67.990	.070	5.219	1.000	1.00	1.00
1- 211	12:11:00	.3389	113.20	2573.000	-68.070	-.080	5.045	1.000	1.00	1.00
1- 212	12:11:10	.3417	113.30	2573.080	-67.990	.080	5.008	1.000	1.00	1.00
1- 213	12:11:20	.3444	113.30	2573.090	-67.980	.010	5.123	1.000	1.00	1.00
1- 214	12:11:30	.3472	113.30	2573.050	-68.020	-.040	4.986	1.000	1.00	1.00
1- 215	12:11:40	.3500	113.30	2573.100	-67.970	.050	5.083	1.000	1.00	1.00
1- 216	12:11:50	.3528	113.30	2573.130	-67.940	.030	5.154	1.000	1.00	1.00
1- 217	12:12:00	.3556	113.40	2573.080	-67.990	-.050	5.141	1.000	1.00	1.00
1- 218	12:12:10	.3583	113.40	2573.010	-68.060	-.070	5.011	1.000	1.00	1.00
1- 219	12:12:20	.3611	113.40	2573.040	-68.030	.030	4.934	1.000	1.00	1.00
1- 220	12:12:30	.3639	113.40	2573.100	-67.970	.060	4.940	1.000	1.00	1.00
1- 221	12:12:40	.3667	113.40	2573.100	-67.970	0.000	4.853	1.000	1.00	1.00
1- 222	12:12:50	.3694	113.50	2573.090	-67.980	-.010	4.434	1.000	1.00	1.00
1- 223	12:13:00	.3722	113.50	2573.150	-67.920	.060	4.248	1.000	1.00	1.00
1- 224	12:13:10	.3750	113.50	2573.160	-67.910	.010	4.067	1.000	1.00	1.00
1- 225	12:13:20	.3778	113.50	2573.150	-67.920	-.010	3.650	1.000	1.00	1.00
1- 226	12:13:30	.3806	113.50	2573.170	-67.900	.020	3.479	1.000	1.00	1.00
1- 227	12:13:40	.3833	113.50	2573.190	-67.880	.020	3.395	1.000	1.00	1.00
1- 228	12:13:50	.3861	113.50	2573.220	-67.850	.030	3.362	1.000	1.00	1.00
1- 229	12:14:00	.3889	113.60	2573.230	-67.840	.010	3.426	1.000	1.00	1.00
1- 230	12:14:10	.3917	113.60	2573.240	-67.830	.010	3.270	1.000	1.00	1.00
1- 231	12:14:20	.3944	113.60	2573.300	-67.770	.060	3.329	1.000	1.00	1.00
1- 232	12:14:30	.3972	113.60	2573.340	-67.730	.040	3.921	1.000	1.00	1.00
1- 233	12:14:40	.4000	113.60	2573.300	-67.770	-.040	4.090	1.000	1.00	1.00
1- 234	12:14:50	.4028	113.70	2573.310	-67.760	.010	4.212	1.000	1.00	1.00
1- 235	12:15:00	.4056	113.70	2573.260	-67.810	-.050	4.337	1.000	1.00	1.00
1- 236	12:15:10	.4083	113.70	2573.260	-67.810	0.000	4.123	1.000	1.00	1.00
1- 237	12:15:20	.4111	113.70	2573.250	-67.820	-.010	4.093	1.000	1.00	1.00
1- 238	12:15:30	.4139	113.70	2573.420	-67.650	.170	4.616	1.000	1.00	1.00
1- 239	12:15:40	.4167	113.70	2573.350	-67.720	-.070	4.672	1.000	1.00	1.00
1- 240	12:15:50	.4194	113.70	2573.430	-67.640	.080	5.090	1.000	1.00	1.00
1- 241	12:16:00	.4222	113.70	2573.440	-67.630	.010	5.558	1.000	1.00	1.00

\* SLOPE DEFINITION: DELTA TIME vs. PRESSURE

# GULF COAST WELL ANALYSIS

## FALL-OFF TEST

FINAL REPORT

PAGE 0004

COMPANY		LEASE/WELL				DATE			
HOECHST CELANESE		WDW 110 # 1-A				MONDAY -- OCTOBER 30, 1989			
FIELD		MEASURED AND TRUE VERTICAL TOOL DEPTHS				MID-PERF TVD AND GRADIENT			
BAY CITY PLANT		5640 FEET -- 5640 FEET				5640 FEET -- .44 PSI/FOOT			
DISC &	REAL TIME DATA	BH	BOTTOM HOLE PRESSURE				SURFACE INFORMATION		
SAMPLE	TIME	dTIME	TEMP.	PRESSURE	DELTA PRESSURE IN PSI	(*)	TUBING	WDW152	WHT
NUMBER	HH:MM:SS	IN HOURS	(F)	IN PSI	P(o)	P (n-1)	SLOPE	IN PSI	IN PSI
1- 242	12:16:10	.4250	113.70	2573.580	-67.490	.140	6.225	1.000	1.00
1- 243	12:16:20	.4278	113.80	2573.470	-67.600	-.110	6.137	1.000	1.00
1- 244	12:16:30	.4306	113.80	2573.520	-67.550	.050	6.195	1.000	1.00
1- 245	12:16:40	.4333	113.80	2573.500	-67.570	-.020	6.270	1.000	1.00
1- 246	12:16:50	.4361	113.80	2573.450	-67.620	-.050	6.067	1.000	1.00
1- 247	12:17:00	.4389	113.80	2573.430	-67.640	-.020	5.666	1.000	1.00
1- 248	12:17:10	.4417	113.80	2573.400	-67.670	-.030	5.286	1.000	1.00
1- 249	12:17:20	.4444	113.90	2573.530	-67.540	.130	5.306	1.000	1.00
1- 250	12:17:30	.4472	113.90	2573.390	-67.680	-.140	4.722	1.000	1.00
1- 251	12:17:40	.4500	113.90	2573.370	-67.700	-.020	4.076	1.000	1.00
1- 252	12:17:50	.4528	113.90	2573.350	-67.720	-.020	3.381	1.000	1.00
1- 253	12:18:00	.4556	113.90	2573.370	-67.700	.020	2.816	1.000	1.00
1- 254	12:18:10	.4583	113.90	2573.380	-67.690	.010	2.279	1.000	1.00
1- 255	12:18:20	.4611	113.90	2573.400	-67.670	.020	1.803	1.000	1.00
1- 256	12:18:30	.4639	113.90	2573.400	-67.670	0.000	1.498	1.000	1.00
1- 257	12:18:40	.4667	114.00	2573.500	-67.570	.100	1.642	1.000	1.00
1- 258	12:18:50	.4694	114.00	2573.490	-67.580	-.010	1.565	1.000	1.00
1- 259	12:19:10	.4750	114.00	2573.420	-67.650	-.070	1.218	1.000	1.00
1- 260	12:19:20	.4778	114.00	2573.390	-67.680	-.030	.572	1.000	1.00
1- 261	12:19:30	.4806	114.00	2573.390	-67.680	0.000	-.088	1.000	1.00
1- 262	12:19:40	.4833	114.00	2573.460	-67.610	.070	-.566	1.000	1.00
1- 263	12:19:50	.4861	114.00	2573.530	-67.540	.070	-.287	1.000	1.00
1- 264	12:20:00	.4889	114.10	2573.460	-67.610	-.070	-.506	1.000	1.00
1- 265	12:20:10	.4917	114.10	2573.470	-67.600	.010	-.452	1.000	1.00
1- 266	12:20:20	.4944	114.10	2573.590	-67.480	.120	-.003	1.000	1.00
1- 267	12:20:30	.4972	114.10	2573.580	-67.490	-.010	.845	1.000	1.00
1- 268	12:20:40	.5000	114.10	2573.620	-67.450	.040	1.440	1.000	1.00
1- 269	12:20:50	.5028	114.10	2573.630	-67.440	.010	2.189	1.000	1.00
1- 270	12:21:00	.5056	114.10	2573.650	-67.420	.020	2.905	1.000	1.00
1- 271	12:21:10	.5083	114.10	2573.700	-67.370	.050	3.570	1.000	1.00
1- 272	12:21:20	.5111	114.20	2573.760	-67.310	.060	4.293	1.000	1.00
1- 273	12:21:30	.5139	114.20	2573.770	-67.300	.010	4.866	1.000	1.00
1- 274	12:21:40	.5167	114.20	2573.830	-67.240	.060	5.976	1.000	1.00
1- 275	12:21:50	.5194	114.20	2573.770	-67.300	-.060	6.361	1.000	1.00
1- 276	12:22:00	.5222	114.20	2573.760	-67.310	-.010	6.558	1.000	1.00
1- 277	12:22:10	.5250	114.20	2573.770	-67.300	.010	6.621	1.000	1.00
1- 278	12:22:20	.5278	114.20	2573.780	-67.290	.010	6.682	1.000	1.00
1- 279	12:22:30	.5306	114.20	2573.810	-67.260	.030	6.770	1.000	1.00
1- 280	12:23:20	.5444	114.30	2573.880	-67.190	.070	6.766	1.000	1.00
1- 281	12:23:30	.5472	114.30	2573.970	-67.100	.090	6.987	1.000	1.00
1- 282	12:23:40	.5500	114.30	2573.990	-67.080	.020	7.449	1.000	1.00
1- 283	12:23:50	.5528	114.30	2573.980	-67.090	-.010	7.720	1.000	1.00
1- 284	12:24:00	.5556	114.30	2574.050	-67.020	.070	7.820	1.000	1.00
1- 285	12:25:00	.5722	114.40	2574.110	-66.960	.060	7.537	1.000	1.00
1- 286	12:26:00	.5889	114.40	2574.130	-66.940	.020	6.877	1.000	1.00
1- 287	12:27:00	.6056	114.50	2574.170	-66.900	.040	6.238	1.000	1.00
1- 288	12:28:00	.6222	114.50	2574.190	-66.880	.020	5.638	1.000	1.00
1- 289	12:29:00	.6389	114.60	2574.220	-66.850	.030	4.981	1.000	1.00
1- 290	12:30:00	.6556	114.60	2574.240	-66.830	.020	4.395	1.000	1.00
1- 291	12:31:00	.6722	114.70	2574.140	-66.930	-.100	3.754	1.000	1.00

\* SLOPE DEFINITION: DELTA TIME vs. PRESSURE

**GULF COAST WELL ANALYSIS**  
FALL-OFF TEST

FINAL REPORT

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COMPANY		LEASE/WELL			DATE		
HOECHST CELANESE		WDW 110 # 1-A			MONDAY -- OCTOBER 30, 1989		
FIELD		MEASURED AND TRUE VERTICAL TOOL DEPTHS			MID-PERF TVD AND GRADIENT		
BAY CITY PLANT		5640 FEET -- 5640 FEET			5640 FEET -- .44 PSI/FOOT		
DISC #	REAL TIME DATA	BH	TIME	TEMP.	PRESSURE	DELTA PRESSURE IN PSI	(*)
SAMPLE NUMBER	HH:MM:SS	IN HOURS	dTIME	(F)	IN PSI	P(o)	P (n-1)
						SLOPE	IN PSI
1- 292	12:32:00	.6889	114.70	2574.250	-66.820	.110	3.382
1- 293	12:33:00	.7056	114.80	2574.290	-66.780	.040	3.109
1- 294	12:34:00	.7222	114.80	2574.310	-66.760	.020	2.864
1- 295	12:35:00	.7389	114.80	2574.400	-66.670	.090	2.730
1- 296	12:36:00	.7556	114.90	2574.440	-66.630	.040	2.635
1- 297	12:37:00	.7722	114.90	2574.440	-66.630	0.000	2.539
1- 298	12:38:00	.7889	115.00	2574.460	-66.610	.020	2.441
1- 299	12:39:00	.8056	115.00	2574.490	-66.580	.030	2.376
1- 300	12:40:00	.8222	115.00	2574.500	-66.570	.010	2.267
1- 301	12:41:00	.8389	115.10	2574.460	-66.610	-.040	2.105
1- 302	12:42:00	.8556	115.10	2574.550	-66.520	.090	1.998
1- 303	12:43:00	.8722	115.20	2574.460	-66.610	-.090	1.816
1- 304	12:44:00	.8889	115.20	2574.490	-66.580	.030	1.657
1- 305	12:45:00	.9056	115.20	2574.470	-66.600	-.020	1.504
1- 306	12:46:00	.9222	115.30	2574.470	-66.600	0.000	1.386
1- 307	12:47:00	.9389	115.30	2574.490	-66.580	.020	1.280
1- 308	12:48:00	.9556	115.30	2574.530	-66.540	.040	1.178
1- 309	12:49:00	.9722	115.40	2574.560	-66.510	.030	1.114
1- 310	12:50:00	.9889	115.40	2574.550	-66.520	-.010	1.057
1- 311	12:51:00	1.0056	115.40	2574.590	-66.480	.040	1.014
1- 312	12:52:00	1.0222	115.50	2574.490	-66.580	-.100	.919
1- 313	12:53:00	1.0389	115.50	2574.570	-66.500	.080	.885
1- 314	12:54:00	1.0556	115.50	2574.560	-66.510	-.010	.806
1- 315	12:55:00	1.0722	115.50	2574.620	-66.450	.060	.776
1- 316	12:56:00	1.0889	115.60	2574.500	-66.570	-.120	.603
1- 317	12:57:00	1.1056	115.60	2574.550	-66.520	.050	.506
1- 318	12:58:00	1.1222	115.60	2574.580	-66.490	.030	.437
1- 319	12:59:00	1.1389	115.60	2574.600	-66.470	.020	.377
1- 320	13:00:00	1.1556	115.70	2574.580	-66.510	-.040	.335
1- 321	13:01:00	1.1722	115.70	2574.690	-66.380	.130	.382
1- 322	13:02:00	1.1889	115.70	2574.550	-66.520	-.140	.340
1- 323	13:03:00	1.2056	115.80	2574.610	-66.460	.060	.338
1- 324	13:04:00	1.2222	115.80	2574.580	-66.490	-.030	.331
1- 325	13:05:00	1.2389	115.80	2574.590	-66.480	.010	.331
1- 326	13:06:00	1.2556	115.80	2574.590	-66.480	0.000	.303
1- 327	13:07:00	1.2722	115.80	2574.540	-66.530	-.050	.295
1- 328	13:08:00	1.2889	115.90	2574.560	-66.510	.020	.245
1- 329	13:09:00	1.3056	115.90	2574.520	-66.550	-.040	.186
1- 330	13:10:00	1.3222	115.90	2574.630	-66.440	.110	.174
1- 331	13:11:00	1.3389	115.90	2574.620	-66.450	-.010	.150
1- 332	13:12:00	1.3556	116.00	2574.660	-66.410	.040	.152
1- 333	13:13:00	1.3722	116.00	2574.640	-66.430	-.020	.160
1- 334	13:14:00	1.3889	116.00	2574.630	-66.440	-.010	.175
1- 335	13:15:00	1.4056	116.00	2574.640	-66.430	.010	.187
1- 336	13:16:00	1.4222	116.00	2574.650	-66.420	.010	.224
1- 337	13:17:00	1.4389	116.10	2574.640	-66.430	-.010	.192
1- 338	13:18:00	1.4556	116.10	2574.580	-66.490	-.060	.169
1- 339	13:19:00	1.4722	116.10	2574.670	-66.400	.090	.189
1- 340	13:20:00	1.4889	116.10	2574.620	-66.450	-.050	.212
1- 341	13:21:00	1.5056	116.10	2574.630	-66.440	.010	.168

\* SLOPE DEFINITION: DELTA TIME vs. PRESSURE

**GULF COAST WELL ANALYSIS**  
**FALL-OFF TEST**

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COMPANY		LEASE/WELL				DATE			
HOECHST CELANESE		WDW 110 # 1-A				MONDAY -- OCTOBER 30, 1989			
FIELD		MEASURED AND TRUE VERTICAL TOOL DEPTHS				MID-PERF TVD AND GRADIENT			
BAY CITY PLANT		5640 FEET -- 5640 FEET				5640 FEET -- .44 PSI/FOOT			
DISC #	REAL TIME DATA	BH	BOTTOM HOLE PRESSURE				SURFACE INFORMATION		
SAMPLE	TIME	dTIME	TEMP.	PRESSURE	DELTA PRESSURE IN PSI	(S)	TUBING	WDW152	WHT
NUMBER	HH:MM:SS	IN HOURS	(F)	IN PSI	P(o)	P (n-1)	SLOPE	IN PSI	IN PSI
1- 342	13:22:00	1.5222	116.20	2574.660	-66.410	.030	.166	1.000	1.00
1- 343	13:23:00	1.5389	116.20	2574.650	-66.420	-.010	.170	1.000	1.00
1- 344	13:24:00	1.5556	116.20	2574.640	-66.430	-.010	.178	1.000	1.00
1- 345	13:25:00	1.5722	116.20	2574.650	-66.420	.010	.166	1.000	1.00
1- 346	13:26:00	1.5889	116.20	2574.670	-66.400	.020	.238	1.000	1.00
1- 347	13:27:00	1.6056	116.30	2574.630	-66.440	-.040	.205	1.000	1.00
1- 348	13:28:00	1.6222	116.30	2574.620	-66.450	-.010	.199	1.000	1.00
1- 349	13:29:00	1.6389	116.30	2574.550	-66.520	-.070	.136	1.000	1.00
1- 350	13:30:00	1.6556	116.30	2574.640	-66.430	.090	.130	1.000	1.00
1- 351	13:31:00	1.6722	116.30	2574.680	-66.390	.040	.144	1.000	1.00
1- 352	13:32:00	1.6889	116.40	2574.700	-66.370	.020	.135	1.000	1.00
1- 353	13:33:00	1.7056	116.40	2574.650	-66.420	-.050	.102	1.000	1.00
1- 354	13:34:00	1.7222	116.40	2574.820	-66.250	.170	.136	1.000	1.00
1- 355	13:35:00	1.7389	116.40	2574.610	-66.460	-.210	.106	1.000	1.00
1- 356	13:36:00	1.7556	116.40	2574.590	-66.480	-.020	.059	1.000	1.00
1- 357	13:37:00	1.7722	116.40	2574.590	-66.480	0.000	.038	1.000	1.00
1- 358	13:38:00	1.7889	116.50	2574.630	-66.440	.040	.030	1.000	1.00
1- 359	13:39:00	1.8056	116.50	2574.610	-66.460	-.020	.006	1.000	1.00
1- 360	13:40:00	1.8222	116.50	2574.620	-66.450	.010	-.006	1.000	1.00
1- 361	13:41:00	1.8389	116.50	2574.590	-66.480	-.030	-.028	1.000	1.00
1- 362	13:42:00	1.8556	116.50	2574.650	-66.420	.060	-.020	1.000	1.00
1- 363	13:43:00	1.8722	116.50	2574.570	-66.500	-.080	-.092	1.000	1.00
1- 364	13:44:00	1.8889	116.60	2574.700	-66.370	.130	-.038	1.000	1.00
1- 365	13:45:00	1.9056	116.60	2574.640	-66.430	-.060	-.049	1.000	1.00
1- 366	13:46:00	1.9222	116.60	2574.600	-66.470	-.040	-.077	1.000	1.00
1- 367	13:47:00	1.9389	116.60	2575.410	-65.660	.810	.364	1.000	1.00
1- 368	13:48:00	1.9556	116.60	2574.780	-66.290	-.630	.414	1.000	1.00
1- 369	13:49:00	1.9722	116.60	2574.720	-66.350	-.060	.420	1.000	1.00
1- 370	13:50:00	1.9889	116.70	2574.650	-66.420	-.070	.389	1.000	1.00
1- 371	13:51:00	2.0056	116.70	2574.650	-66.420	0.000	.370	1.000	1.00
1- 372	13:52:00	2.0222	116.70	2574.620	-66.450	-.030	.312	1.000	1.00
1- 373	13:53:00	2.0389	116.70	2574.580	-66.490	-.040	.225	1.000	1.00
1- 374	13:54:00	2.0556	116.70	2574.610	-66.460	.030	.115	1.000	1.00
1- 375	13:55:00	2.0722	116.70	2574.640	-66.430	.030	.073	1.000	1.00
1- 376	13:56:00	2.0889	116.80	2574.670	-66.400	.030	.072	1.000	1.00
1- 377	13:57:00	2.1056	116.80	2574.690	-66.380	.020	.094	1.000	1.00
1- 378	13:58:00	2.1222	116.80	2574.620	-66.450	-.070	.048	1.000	1.00
1- 379	13:59:00	2.1389	116.80	2574.640	-66.430	.020	.116	1.000	1.00
1- 380	14:00:00	2.1556	116.80	2574.590	-66.480	-.050	.039	1.000	1.00
1- 381	14:01:00	2.1722	116.80	2574.650	-66.420	.060	-.016	1.000	1.00
1- 382	14:02:00	2.1889	116.80	2574.680	-66.390	.030	-.057	1.000	1.00
1- 383	14:03:00	2.2056	116.90	2574.580	-66.490	-.100	-.133	1.000	1.00
1- 384	14:04:00	2.2222	116.90	2574.590	-66.480	.010	-.214	1.000	1.00
1- 385	14:05:00	2.2389	116.90	2574.620	-66.450	.030	-.271	1.000	1.00
1- 386	14:06:00	2.2556	116.90	2574.590	-66.480	-.030	-.363	1.000	1.00
1- 387	14:07:00	2.2722	116.90	2574.680	-66.390	.090	-.369	1.000	1.00
1- 388	14:08:00	2.2889	116.90	2574.680	-66.390	0.000	-.425	1.000	1.00
1- 389	14:09:00	2.3056	116.90	2574.580	-66.490	-.100	-.462	1.000	1.00
1- 390	14:10:00	2.3222	117.00	2574.630	-66.440	.050	-.503	1.000	1.00
1- 391	14:11:00	2.3389	117.00	2574.570	-66.500	-.060	-.600	1.000	1.00

\* SLOPE DEFINITION:DELTA TIME vs. PRESSURE

**GULF COAST WELL ANALYSIS**  
**FALL-OFF TEST**

FINAL REPORT

PAGE 0007

COMPANY		LEASE/WELL				DATE			
HOECHST CELANESE		WDW 110 # 1-A				MONDAY -- OCTOBER 30, 1989			
FIELD		MEASURED AND TRUE VERTICAL TOOL DEPTHS				MID-PERF TVD AND GRADIENT			
BAY CITY PLANT		5640 FEET -- 5640 FEET				5640 FEET -- .44 PSI/FOOT			
DISC &	REAL TIME DATA	BH	BOTTOM HOLE PRESSURE				SURFACE INFORMATION		
SAMPLE	TIME	dTIME	TEMP.	PRESSURE	DELTA PRESSURE IN PSI	(S)	TUBING	WDW152	MHT
NUMBER	HH:MM:SS	IN HOURS	(F)	IN PSI	P(o)	P (n-1)	SLOPE	IN PSI	IN PSI
1- 392	14:12:00	2.3556	117.00	2574.550	-66.520	.020	.222	1.000	1.00
1- 393	14:13:00	2.3722	117.00	2574.640	-66.430	.090	.131	1.000	1.00
1- 394	14:14:00	2.3889	117.00	2574.630	-66.440	.010	.076	1.000	1.00
1- 395	14:15:00	2.4056	117.00	2574.640	-66.430	.010	.053	1.000	1.00
1- 396	14:16:00	2.4222	117.00	2574.610	-66.460	.030	.046	1.000	1.00
1- 397	14:17:00	2.4389	117.00	2574.640	-66.430	.030	.038	1.000	1.00
1- 398	14:18:00	2.4556	117.00	2574.640	-66.430	0.000	.056	1.000	1.00
1- 399	14:19:00	2.4722	117.10	2574.570	-66.500	.070	.097	1.000	1.00
1- 400	14:20:00	2.4889	117.10	2574.620	-66.450	.050	.090	1.000	1.00
1- 401	14:21:00	2.5056	117.10	2574.570	-66.500	.050	.093	1.000	1.00
1- 402	14:22:00	2.5222	117.10	2574.580	-66.490	.010	.073	1.000	1.00
1- 403	14:23:00	2.5389	117.10	2574.650	-66.420	.070	.051	1.000	1.00
1- 404	14:24:00	2.5556	117.10	2574.580	-66.490	.070	.058	1.000	1.00
1- 405	14:25:00	2.5722	117.10	2574.650	-66.420	.070	.053	1.000	1.00
1- 406	14:26:00	2.5889	117.20	2574.660	-66.410	.010	.009	1.000	1.00
1- 407	14:27:00	2.6056	117.20	2574.520	-66.550	.140	.025	1.000	1.00
1- 408	14:28:00	2.6222	117.20	2574.600	-66.470	.080	.049	1.000	1.00
1- 409	14:29:00	2.6389	117.20	2574.560	-66.510	.040	.091	1.000	1.00
1- 410	14:30:00	2.6556	117.20	2574.630	-66.440	.070	.074	1.000	1.00
1- 411	14:31:00	2.6722	117.20	2574.590	-66.480	.040	.098	1.000	1.00
1- 412	14:32:00	2.6889	117.20	2574.690	-66.380	.100	.013	1.000	1.00
1- 413	14:33:00	2.7056	117.20	2574.580	-66.490	.110	.011	1.000	1.00
1- 414	14:34:00	2.7222	117.20	2574.620	-66.450	.040	.002	1.000	1.00
1- 415	14:35:00	2.7389	117.20	2574.580	-66.490	.040	.001	1.000	1.00
1- 416	14:36:00	2.7556	117.30	2574.710	-66.360	.130	.034	1.000	1.00
1- 417	14:37:00	2.7722	117.30	2574.570	-66.500	.140	.027	1.000	1.00
1- 418	14:38:00	2.7889	117.30	2574.550	-66.520	.020	.046	1.000	1.00
1- 419	14:39:00	2.8056	117.30	2574.600	-66.470	.050	.039	1.000	1.00
1- 420	14:40:00	2.8222	117.30	2574.590	-66.480	.010	.030	1.000	1.00
1- 421	14:41:00	2.8389	117.30	2574.570	-66.500	.020	.048	1.000	1.00
1- 422	14:42:00	2.8556	117.30	2574.540	-66.530	.030	.063	1.000	1.00
1- 423	14:43:00	2.8722	117.30	2574.560	-66.510	.020	.062	1.000	1.00
1- 424	14:44:00	2.8889	117.40	2574.540	-66.530	.020	.111	1.000	1.00
1- 425	14:45:00	2.9056	117.40	2574.590	-66.480	.050	.100	1.000	1.00
1- 426	14:46:00	2.9222	117.40	2574.570	-66.500	.020	.129	1.000	1.00
1- 427	14:47:00	2.9389	117.40	2574.590	-66.480	.020	.141	1.000	1.00
1- 428	14:48:00	2.9556	117.40	2574.560	-66.510	.030	.128	1.000	1.00
1- 429	14:49:00	2.9722	117.40	2574.570	-66.500	.010	.148	1.000	1.00
1- 430	14:50:00	2.9889	117.40	2574.550	-66.520	.020	.136	1.000	1.00
1- 431	14:51:00	3.0056	117.40	2574.600	-66.470	.050	.085	1.000	1.00
1- 432	14:52:00	3.0222	117.40	2574.600	-66.470	0.000	.116	1.000	1.00
1- 433	14:53:00	3.0389	117.50	2574.620	-66.450	.020	.092	1.000	1.00
1- 434	14:54:00	3.0556	117.50	2574.560	-66.510	.060	.126	1.000	1.00
1- 435	14:55:00	3.0722	117.50	2574.530	-66.540	.030	.134	1.000	1.00
1- 436	14:56:00	3.0889	117.50	2574.540	-66.530	.010	.156	1.000	1.00
1- 437	14:57:00	3.1056	117.50	2574.530	-66.540	.010	.121	1.000	1.00
1- 438	14:58:00	3.1222	117.50	2574.620	-66.450	.090	.096	1.000	1.00
1- 439	14:59:00	3.1389	117.50	2574.370	-66.700	.250	.186	1.000	1.00
1- 440	15:00:00	3.1556	117.50	2574.590	-66.480	.220	.167	1.000	1.00
1- 441	15:01:00	3.1722	117.50	2574.580	-66.490	.010	.076	1.000	1.00

\* SLOPE DEFINITION: DELTA TIME vs. PRESSURE

**GULF COAST WELL ANALYSIS**  
**FALL-OFF TEST**

FINAL REPORT

PAGE 0008

COMPANY				LEASE/WELL				DATE			
HOECHST CELANESE				MDW 110 # 1-A				MONDAY -- OCTOBER 30, 1989			
FIELD				MEASURED AND TRUE VERTICAL TOOL DEPTHS				MID-PERF TVD AND GRADIENT			
BAY CITY PLANT				5640 FEET -- 5640 FEET				5640 FEET -- .44 PSI/FOOT			
DISC &	REAL TIME DATA			BH	BOTTOM HOLE PRESSURE				SURFACE INFORMATION		
SAMPLE	TIME	dtIME		BH	TEMP.	PRESSURE	DELTA PRESSURE IN PSI	(t)	TUBING	MDW152	WT
NUMBER	HH:MM:SS	IN HOURS	(F)		IN PSI	P(o)	P (n-1)	(t)	IN PSI	IN PSI	DEGREES F
1- 442	15:02:00	3.1889	117.50		2574.570	-66.500	-.010	-.069	1.000	1.00	1.00
1- 443	15:03:00	3.2056	117.50		2574.540	-66.530	-.030	-.090	1.000	1.00	1.00
1- 444	15:04:00	3.2222	117.60		2574.620	-66.450	.080	-.036	1.000	1.00	1.00
1- 445	15:05:00	3.2389	117.60		2574.580	-66.490	-.040	-.012	1.000	1.00	1.00
1- 446	15:06:00	3.2556	117.60		2574.540	-66.530	-.040	-.021	1.000	1.00	1.00
1- 447	15:07:00	3.2722	117.60		2574.550	-66.520	.010	-.042	1.000	1.00	1.00
1- 448	15:08:00	3.2889	117.60		2574.540	-66.530	-.010	-.056	1.000	1.00	1.00
1- 449	15:09:00	3.3056	117.60		2574.550	-66.520	.010	-.076	1.000	1.00	1.00
1- 450	15:10:00	3.3222	117.60		2574.640	-66.430	.090	-.016	1.000	1.00	1.00
1- 451	15:11:00	3.3389	117.60		2574.520	-66.550	-.120	-.037	1.000	1.00	1.00
1- 452	15:12:00	3.3556	117.70		2574.640	-66.430	.120	.022	1.000	1.00	1.00
1- 453	15:13:00	3.3722	117.60		2574.570	-66.500	-.070	.023	1.000	1.00	1.00
1- 454	15:14:00	3.3889	117.70		2574.620	-66.450	.050	.056	1.000	1.00	1.00
1- 455	15:15:00	3.4056	117.70		2574.520	-66.550	-.100	.020	1.000	1.00	1.00
1- 456	15:16:00	3.4222	117.70		2574.540	-66.530	.020	.027	1.000	1.00	1.00
1- 457	15:17:00	3.4389	117.70		2574.520	-66.550	-.020	.025	1.000	1.00	1.00
1- 458	15:18:00	3.4556	117.70		2574.560	-66.510	.040	.061	1.000	1.00	1.00
1- 459	15:19:00	3.4722	117.70		2574.430	-66.640	-.130	-.008	1.000	1.00	1.00
1- 460	15:20:00	3.4889	117.70		2575.190	-65.880	.760	.331	1.000	1.00	1.00
1- 461	15:21:00	3.5056	117.70		2574.790	-66.280	-.400	.425	1.000	1.00	1.00
1- 462	15:22:00	3.5222	117.80		2574.630	-66.440	-.160	.413	1.000	1.00	1.00
1- 463	15:23:00	3.5389	117.80		2574.550	-66.520	-.080	.405	1.000	1.00	1.00
1- 464	15:24:00	3.5556	117.80		2574.600	-66.470	.050	.279	1.000	1.00	1.00
1- 465	15:25:00	3.5722	117.80		2574.630	-66.440	.030	.290	1.000	1.00	1.00
1- 466	15:26:00	3.5889	117.80		2574.540	-66.530	-.090	.244	1.000	1.00	1.00
1- 467	15:27:00	3.6056	117.80		2574.460	-66.610	-.080	.150	1.000	1.00	1.00
1- 468	15:28:00	3.6222	117.80		2574.490	-66.580	.030	.059	1.000	1.00	1.00
1- 469	15:29:00	3.6389	117.80		2574.560	-66.510	.070	.057	1.000	1.00	1.00
1- 470	15:30:00	3.6556	117.80		2574.540	-66.530	-.020	.023	1.000	1.00	1.00
1- 471	15:31:00	3.6722	117.80		2574.540	-66.530	0.000	-.034	1.000	1.00	1.00
1- 472	15:32:00	3.6889	117.80		2574.500	-66.570	-.040	-.106	1.000	1.00	1.00
1- 473	15:33:00	3.7056	117.90		2574.490	-66.580	-.010	-.188	1.000	1.00	1.00
1- 474	15:34:00	3.7222	117.90		2574.490	-66.580	0.000	-.261	1.000	1.00	1.00
1- 475	15:35:00	3.7389	117.90		2574.550	-66.520	.060	-.245	1.000	1.00	1.00
1- 476	15:36:00	3.7556	117.90		2574.580	-66.490	.030	-.279	1.000	1.00	1.00
1- 477	15:37:00	3.7722	117.90		2574.630	-66.440	.050	-.217	1.000	1.00	1.00
1- 478	15:38:00	3.7889	117.90		2574.510	-66.560	-.120	-.263	1.000	1.00	1.00
1- 479	15:39:00	3.8056	117.90		2574.530	-66.540	.020	-.264	1.000	1.00	1.00
1- 480	15:40:00	3.8222	117.90		2574.590	-66.480	.060	-.289	1.000	1.00	1.00
1- 481	15:41:00	3.8389	117.90		2574.580	-66.490	-.010	-.310	1.000	1.00	1.00
1- 482	15:42:00	3.8556	117.90		2574.510	-66.560	-.070	-.384	1.000	1.00	1.00
1- 483	15:43:00	3.8722	117.90		2574.590	-66.480	.080	-.389	1.000	1.00	1.00
1- 484	15:44:00	3.8889	118.00		2574.470	-66.600	-.120	-.540	1.000	1.00	1.00
1- 485	15:45:00	3.9056	118.00		2574.530	-66.540	.060	-.204	1.000	1.00	1.00
1- 486	15:46:00	3.9222	118.00		2574.520	-66.550	-.010	-.082	1.000	1.00	1.00
1- 487	15:47:00	3.9389	118.00		2574.540	-66.530	.020	-.033	1.000	1.00	1.00
1- 488	15:48:00	3.9556	118.00		2574.500	-66.570	-.040	-.050	1.000	1.00	1.00
1- 489	15:49:00	3.9722	118.00		2574.500	-66.570	0.000	-.035	1.000	1.00	1.00
1- 490	15:50:00	3.9889	118.00		2574.570	-66.500	.070	.042	1.000	1.00	1.00
1- 491	15:51:00	4.0056	118.00		2574.500	-66.570	-.070	.028	1.000	1.00	1.00

\* SLOPE DEFINITION: DELTA TIME vs. PRESSURE

**GULF COAST WELL ANALYSIS**  
**FALL-OFF TEST**

FINAL REPORT

PAGE 0009

COMPANY			LEASE/WELL			DATE			
HODECHST DELANESE			WDW 110 # 1-A			MONDAY -- OCTOBER 30, 1989			
FIELD			MEASURED AND TRUE VERTICAL TOOL DEPTHS			MID-PERF TVD AND GRADIENT			
BAY CITY PLANT			5640 FEET -- 5640 FEET			5640 FEET -- .44 PSI/FOOT			
DISC &	REAL TIME DATA	BH	BOTTOM HOLE PRESSURE			SURFACE INFORMATION			
SAMPLE	TIME	dTIME	TEMP.	PRESSURE	DELTA PRESSURE IN PSI	(S)	TUBING	WDW152	NHT
NUMBER	HH:MM:SS	IN HOURS	(F)	IN PSI	P(n)	P(n-1)	IN PSI	IN PSI	DEGREES F
1- 492	15:52:00	4.0222	118.00	2574.530	-66.540	.030	-0.015	1.000	1.00
1- 493	15:53:00	4.0389	118.00	2574.600	-66.470	.070	-0.004	1.000	1.00
1- 494	15:54:00	4.0556	118.00	2574.490	-66.580	-.110	-0.018	1.000	1.00
1- 495	15:55:00	4.0722	118.00	2574.510	-66.560	.020	-0.029	1.000	1.00
1- 496	15:56:00	4.0889	118.10	2574.520	-66.550	.010	-0.033	1.000	1.00
1- 497	15:57:00	4.1056	118.10	2574.530	-66.540	.010	-0.054	1.000	1.00
1- 498	15:58:00	4.1222	118.10	2574.500	-66.570	-.030	-0.100	1.000	1.00
1- 499	15:59:00	4.1389	118.10	2574.490	-66.580	-.010	-0.152	1.000	1.00
1- 500	16:00:00	4.1556	118.10	2574.550	-66.520	.060	-0.134	1.000	1.00
1- 501	16:01:00	4.1722	118.10	2574.510	-66.560	-.040	-0.121	1.000	1.00
1- 502	16:02:00	4.1889	118.10	2574.520	-66.550	.010	-0.069	1.000	1.00
1- 503	16:03:00	4.2056	118.10	2574.520	-66.550	0.000	-0.084	1.000	1.00
1- 504	16:04:00	4.2222	118.10	2574.550	-66.520	.030	-0.070	1.000	1.00
1- 505	16:05:00	4.2389	118.10	2574.500	-66.570	-.050	-0.049	1.000	1.00
1- 506	16:06:00	4.2556	118.10	2574.550	-66.520	.050	-0.003	1.000	1.00
1- 507	16:07:00	4.2722	118.10	2574.470	-66.600	-.080	-0.041	1.000	1.00
1- 508	16:08:00	4.2889	118.10	2574.490	-66.580	.020	-0.018	1.000	1.00
1- 509	16:09:00	4.3056	118.10	2574.440	-66.630	-.050	-0.091	1.000	1.00
1- 510	16:10:00	4.3222	118.20	2574.490	-66.580	.050	-0.098	1.000	1.00
1- 511	16:11:00	4.3389	118.20	2574.500	-66.570	.010	-0.104	1.000	1.00
1- 512	16:12:00	4.3556	118.20	2574.450	-66.620	-.050	-0.125	1.000	1.00
1- 513	16:13:00	4.3722	118.20	2574.490	-66.580	.040	-0.144	1.000	1.00
1- 514	16:14:00	4.3889	118.20	2574.540	-66.530	.050	-0.134	1.000	1.00
1- 515	16:15:00	4.4056	118.20	2574.450	-66.620	-.090	-0.134	1.000	1.00
1- 516	16:16:00	4.4222	118.20	2574.510	-66.560	.060	-0.137	1.000	1.00
1- 517	16:17:00	4.4389	118.20	2574.550	-66.520	.040	-0.101	1.000	1.00
1- 518	16:18:00	4.4556	118.20	2574.490	-66.580	-.060	-0.056	1.000	1.00
1- 519	16:19:00	4.4722	118.20	2574.500	-66.570	.010	-0.067	1.000	1.00
1- 520	16:20:00	4.4889	118.30	2574.490	-66.580	-.010	-0.072	1.000	1.00
1- 521	16:21:00	4.5056	118.30	2574.460	-66.610	-.030	-0.087	1.000	1.00
1- 522	16:22:00	4.5222	118.30	2574.480	-66.590	.020	-0.082	1.000	1.00
1- 523	16:23:00	4.5389	118.30	2574.440	-66.630	-.040	-0.115	1.000	1.00
1- 524	16:24:00	4.5556	118.30	2574.530	-66.540	.090	-0.101	1.000	1.00
1- 525	16:25:00	4.5722	118.30	2574.490	-66.580	-.040	-0.075	1.000	1.00
1- 526	16:26:00	4.5889	118.30	2574.480	-66.590	-.010	-0.076	1.000	1.00
1- 527	16:27:00	4.6056	118.30	2574.410	-66.660	-.070	-0.108	1.000	1.00
1- 528	16:28:00	4.6222	118.30	2574.490	-66.580	.080	-0.091	1.000	1.00
1- 529	16:29:00	4.6389	118.30	2574.440	-66.630	-.050	-0.083	1.000	1.00
1- 530	16:30:00	4.6556	118.30	2574.510	-66.560	.070	-0.060	1.000	1.00
1- 531	16:31:00	4.6722	118.30	2574.510	-66.560	0.000	-0.008	1.000	1.00
1- 532	16:32:00	4.6889	118.30	2574.430	-66.640	-.080	-0.046	1.000	1.00
1- 533	16:33:00	4.7056	118.30	2574.430	-66.640	0.000	-0.071	1.000	1.00
1- 534	16:34:00	4.7222	118.40	2574.450	-66.620	.020	-0.111	1.000	1.00
1- 535	16:35:00	4.7389	118.40	2574.530	-66.540	.080	-0.078	1.000	1.00
1- 536	16:36:00	4.7556	118.40	2574.470	-66.600	-.060	-0.074	1.000	1.00
1- 537	16:37:00	4.7722	118.40	2574.350	-66.720	-.120	-0.165	1.000	1.00
1- 538	16:38:00	4.7889	118.40	2574.520	-66.550	.170	-0.133	1.000	1.00
1- 539	16:39:00	4.8056	118.40	2574.470	-66.600	-.050	-0.100	1.000	1.00
1- 540	16:40:00	4.8222	118.40	2574.490	-66.580	.020	-0.107	1.000	1.00
1- 541	16:41:00	4.8389	118.40	2574.430	-66.640	-.060	-0.113	1.000	1.00

\* SLOPE DEFINITION:DELTA TIME vs. PRESSURE

# GULF COAST WELL ANALYSIS

FALL-OFF TEST

FINAL REPORT

PAGE 0010

COMPANY				LEASE/WELL				DATE			
MOECHST CELANESE				MDW 110 # 1-A				MONDAY -- OCTOBER 30, 1989			
FIELD				MEASURED AND TRUE VERTICAL TOOL DEPTHS				MID-PERF TVD AND GRADIENT			
BAY CITY PLANT				5640 FEET -- 5640 FEET				5640 FEET -- .44 PSI/FOOT			
DISC #	REAL TIME DATA	BH		BOTTOM HOLE PRESSURE				SURFACE INFORMATION			
SAMPLE #	TIME	TIME	TEMP.	PRESSURE	DELTA PRESSURE IN PSI	(#)	TUBING	MDW152	WHT		
NUMBER	HH:MM:SS	IN HOURS	(F)	IN PSI	P(n)	P (n-1)	SLOPE	IN PSI	IN PSI	DEGREES F	
1- 542	16:42:00	4.8556	118.40	2574.440	-66.630	.010	-.086	1.000	1.00	1.00	
1- 543	16:43:00	4.8722	118.40	2574.400	-66.670	-.040	-.112	1.000	1.00	1.00	
1- 544	16:44:00	4.8889	118.40	2574.390	-66.680	-.010	-.133	1.000	1.00	1.00	
1- 545	16:45:00	4.9056	118.40	2574.470	-66.600	.080	-.111	1.000	1.00	1.00	
1- 546	16:46:00	4.9222	118.40	2574.420	-66.650	-.050	-.133	1.000	1.00	1.00	
1- 547	16:47:00	4.9389	118.40	2574.390	-66.680	-.030	-.159	1.000	1.00	1.00	
1- 548	16:48:00	4.9556	118.50	2574.470	-66.600	.080	-.160	1.000	1.00	1.00	
1- 549	16:49:00	4.9722	118.50	2574.490	-66.580	.020	-.097	1.000	1.00	1.00	
1- 550	16:50:00	4.9889	118.50	2574.500	-66.570	.010	-.051	1.000	1.00	1.00	
1- 551	16:51:00	5.0056	118.50	2574.410	-66.660	-.090	-.061	1.000	1.00	1.00	
1- 552	16:52:00	5.0222	118.50	2574.500	-66.570	.090	-.060	1.000	1.00	1.00	
1- 553	16:53:00	5.0389	118.50	2574.460	-66.610	-.040	-.037	1.000	1.00	1.00	
1- 554	16:54:00	5.0556	118.50	2574.430	-66.640	-.030	-.060	1.000	1.00	1.00	
1- 555	16:55:00	5.0722	118.50	2574.370	-66.700	-.060	-.073	1.000	1.00	1.00	
1- 556	16:56:00	5.0889	118.50	2574.440	-66.630	.070	-.042	1.000	1.00	1.00	
1- 557	16:57:00	5.1056	118.50	2574.470	-66.600	.030	-.038	1.000	1.00	1.00	
1- 558	16:58:00	5.1222	118.50	2574.450	-66.620	-.020	-.047	1.000	1.00	1.00	
1- 559	16:59:00	5.1389	118.50	2574.400	-66.670	-.050	-.073	1.000	1.00	1.00	
1- 560	17:00:00	5.1556	118.50	2574.380	-66.690	-.020	-.060	1.000	1.00	1.00	
1- 561	17:01:00	5.1722	118.60	2574.380	-66.690	0.000	-.075	1.000	1.00	1.00	
1- 562	17:02:00	5.1889	118.60	2574.230	-66.840	-.150	-.242	1.000	1.00	1.00	
1- 563	17:03:00	5.2056	118.60	2574.390	-66.680	.160	-.212	1.000	1.00	1.00	
1- 564	17:04:00	5.2222	118.60	2574.490	-66.580	.100	-.151	1.000	1.00	1.00	
1- 565	17:05:00	5.2389	118.60	2574.390	-66.680	-.100	-.135	1.000	1.00	1.00	
1- 566	17:06:00	5.2556	118.60	2574.390	-66.680	0.000	-.150	1.000	1.00	1.00	
1- 567	17:07:00	5.2722	118.60	2574.420	-66.650	.030	-.140	1.000	1.00	1.00	
1- 568	17:08:00	5.2889	118.60	2574.370	-66.700	-.050	-.181	1.000	1.00	1.00	
1- 569	17:09:00	5.3056	118.60	2574.430	-66.640	.060	-.193	1.000	1.00	1.00	
1- 570	17:10:00	5.3222	118.60	2574.360	-66.710	-.070	-.198	1.000	1.00	1.00	
1- 571	17:11:00	5.3389	118.60	2574.380	-66.690	.020	-.217	1.000	1.00	1.00	
1- 572	17:12:00	5.3556	118.60	2574.410	-66.660	.030	-.236	1.000	1.00	1.00	
1- 573	17:13:00	5.3722	118.60	2574.470	-66.600	.060	-.174	1.000	1.00	1.00	
1- 574	17:14:00	5.3889	118.60	2574.270	-66.800	-.200	-.211	1.000	1.00	1.00	
1- 575	17:15:00	5.4056	118.70	2574.420	-66.650	.150	-.149	1.000	1.00	1.00	
1- 576	17:16:00	5.4222	118.70	2574.390	-66.680	-.030	-.153	1.000	1.00	1.00	
1- 577	17:17:00	5.4389	118.70	2574.400	-66.670	.010	-.097	1.000	1.00	1.00	
1- 578	17:18:00	5.4556	118.70	2574.400	-66.670	0.000	-.061	1.000	1.00	1.00	
1- 579	17:19:00	5.4722	118.70	2574.330	-66.740	-.070	-.078	1.000	1.00	1.00	
1- 580	17:20:00	5.4889	118.70	2574.240	-66.830	-.090	-.177	1.000	1.00	1.00	
1- 581	17:21:00	5.5056	118.70	2574.370	-66.700	.130	-.156	1.000	1.00	1.00	
1- 582	17:22:00	5.5222	118.70	2574.380	-66.690	.010	-.108	1.000	1.00	1.00	
1- 583	17:23:00	5.5389	118.70	2574.370	-66.700	-.010	-.073	1.000	1.00	1.00	
1- 584	17:24:00	5.5556	118.70	2574.360	-66.710	-.010	-.071	1.000	1.00	1.00	
1- 585	17:25:00	5.5722	118.70	2574.380	-66.690	.020	-.067	1.000	1.00	1.00	
1- 586	17:26:00	5.5889	118.70	2574.340	-66.730	-.040	-.085	1.000	1.00	1.00	
1- 587	17:27:00	5.6056	118.70	2574.440	-66.630	.100	-.137	1.000	1.00	1.00	
1- 588	17:28:00	5.6222	118.70	2574.380	-66.690	-.060	-.135	1.000	1.00	1.00	
1- 589	17:29:00	5.6389	118.70	2574.340	-66.730	-.040	-.095	1.000	1.00	1.00	
1- 590	17:30:00	5.6556	118.70	2574.400	-66.670	.060	-.074	1.000	1.00	1.00	
1- 591	17:31:00	5.6722	118.70	2574.520	-66.550	.120	-.012	1.000	1.00	1.00	

\* SLOPE DEFINITION:DELTA TIME vs. PRESSURE

**GULF COAST WELL ANALYSIS**  
**FALL-OFF TEST**

FINAL REPORT

PAGE 0011

COMPANY				LEASE/WELL				DATE			
HOECHST DELANESE				WDW 110 # 1-A				MONDAY -- OCTOBER 30, 1989			
FIELD				MEASURED AND TRUE VERTICAL TOOL DEPTHS				MID-PERF TVD AND GRADIENT			
BAY CITY PLANT				5640 FEET -- 5640 FEET				5640 FEET -- .44 PSI/FOOT			
DISC #	REAL TIME DATA			BH	BOTTOM HOLE PRESSURE				SURFACE INFORMATION		
SAMPLE NUMBER	TIME HH:MM:SS	IN HOURS	dTIME	TEMP. (F)	PRESSURE IN PSI	DELTA PRESSURE IN PSI P(o)	P (n-1)	(t)	TUBING SLOPE IN PSI	WDW152 IN PSI	NHT DEGREES F
1- 592	17:32:00	5.6889		118.80	2574.550	-66.520	.030	.127	1.000	1.00	1.00
1- 593	17:33:00	5.7056		118.80	2574.390	-66.680	-.160	.117	1.000	1.00	1.00
1- 594	17:34:00	5.7222		118.80	2574.320	-66.750	-.070	.104	1.000	1.00	1.00
1- 595	17:35:00	5.7389		118.80	2574.320	-66.750	0.000	.054	1.000	1.00	1.00
1- 596	17:36:00	5.7556		118.80	2574.380	-66.690	.060	.050	1.000	1.00	1.00
1- 597	17:37:00	5.7722		118.80	2574.320	-66.750	-.060	.032	1.000	1.00	1.00
1- 598	17:38:00	5.7889		118.80	2574.300	-66.770	-.020	.042	1.000	1.00	1.00
1- 599	17:39:00	5.8056		118.80	2574.340	-66.730	.040	-.037	1.000	1.00	1.00
1- 600	17:40:00	5.8222		118.80	2574.430	-66.640	.090	.020	1.000	1.00	1.00
1- 601	17:41:00	5.8389		118.80	2574.320	-66.750	-.110	-.002	1.000	1.00	1.00
1- 602	17:42:00	5.8556		118.80	2574.050	-67.020	-.270	-.164	1.000	1.00	1.00
1- 603	17:43:00	5.8722		118.80	2574.380	-66.690	.330	-.128	1.000	1.00	1.00
1- 604	17:44:00	5.8889		118.80	2574.370	-66.700	-.010	-.138	1.000	1.00	1.00
1- 605	17:45:00	5.9056		118.80	2574.340	-66.730	-.030	-.221	1.000	1.00	1.00
1- 606	17:46:00	5.9222		118.80	2574.370	-66.700	.030	-.213	1.000	1.00	1.00
1- 607	17:47:00	5.9389		118.90	2574.400	-66.670	.030	-.183	1.000	1.00	1.00
1- 608	17:48:00	5.9556		118.90	2574.300	-66.770	-.100	-.216	1.000	1.00	1.00
1- 609	17:49:00	5.9722		118.90	2574.340	-66.730	.040	-.228	1.000	1.00	1.00
1- 610	17:50:00	5.9889		118.90	2574.320	-66.750	-.020	-.240	1.000	1.00	1.00
1- 611	17:51:00	6.0056		118.90	2574.390	-66.680	.070	-.233	1.000	1.00	1.00
1- 612	17:52:00	6.0222		118.90	2574.360	-66.710	-.030	-.186	1.000	1.00	1.00
1- 613	17:53:00	6.0389		118.90	2574.310	-66.760	-.050	-.198	1.000	1.00	1.00
1- 614	17:54:00	6.0556		118.90	2574.510	-66.560	.200	-.120	1.000	1.00	1.00
1- 615	17:55:00	6.0722		118.90	2574.340	-66.730	-.170	-.109	1.000	1.00	1.00
1- 616	17:56:00	6.0889		118.90	2574.330	-66.740	-.010	-.028	1.000	1.00	1.00
1- 617	17:57:00	6.1056		118.90	2574.300	-66.770	-.030	.063	1.000	1.00	1.00
1- 618	17:58:00	6.1222		118.90	2574.350	-66.720	.050	.097	1.000	1.00	1.00
1- 619	17:59:00	6.1389		118.90	2574.350	-66.720	0.000	.091	1.000	1.00	1.00
1- 620	18:00:00	6.1556		118.90	2574.260	-66.810	-.090	.034	1.000	1.00	1.00
1- 621	18:01:00	6.1722		118.90	2574.330	-66.740	.070	.054	1.000	1.00	1.00
1- 622	18:02:00	6.1889		118.90	2574.320	-66.750	-.010	.035	1.000	1.00	1.00
1- 623	18:03:00	6.2056		118.90	2574.370	-66.700	.050	.032	1.000	1.00	1.00
1- 624	18:04:00	6.2222		118.90	2574.250	-66.820	-.120	-.017	1.000	1.00	1.00
1- 625	18:05:00	6.2389		119.00	2574.360	-66.710	.110	.053	1.000	1.00	1.00
1- 626	18:06:00	6.2556		119.00	2574.310	-66.760	-.050	.033	1.000	1.00	1.00
1- 627	18:07:00	6.2722		119.00	2574.300	-66.770	-.010	-.155	1.000	1.00	1.00
1- 628	18:08:00	6.2889		119.00	2574.350	-66.720	.050	-.128	1.000	1.00	1.00
1- 629	18:09:00	6.3056		119.00	2574.350	-66.720	0.000	-.106	1.000	1.00	1.00
1- 630	18:10:00	6.3222		119.00	2574.370	-66.700	.020	-.090	1.000	1.00	1.00
1- 631	18:11:00	6.3389		119.00	2574.320	-66.750	-.050	-.084	1.000	1.00	1.00
1- 632	18:12:00	6.3556		119.00	2574.340	-66.730	.020	-.048	1.000	1.00	1.00
1- 633	18:13:00	6.3722		119.00	2574.590	-66.480	.250	.070	1.000	1.00	1.00
1- 634	18:14:00	6.3889		119.00	2574.340	-66.730	-.250	.060	1.000	1.00	1.00
1- 635	18:15:00	6.4056		119.00	2574.380	-66.690	.040	.060	1.000	1.00	1.00
1- 636	18:16:00	6.4222		119.00	2574.320	-66.750	-.060	.066	1.000	1.00	1.00
1- 637	18:17:00	6.4389		119.00	2574.330	-66.740	.010	.062	1.000	1.00	1.00
1- 638	18:18:00	6.4556		119.00	2574.300	-66.770	-.030	.014	1.000	1.00	1.00
1- 639	18:19:00	6.4722		119.00	2574.470	-66.600	.170	.180	1.000	1.00	1.00
1- 640	18:20:00	6.4889		119.00	2574.300	-66.770	-.170	.152	1.000	1.00	1.00
1- 641	18:21:00	6.5056		119.10	2574.310	-66.760	.010	.125	1.000	1.00	1.00

\* SLOPE DEFINITION:DELTA TIME vs. PRESSURE

**GULF COAST WELL ANALYSIS**  
**FALL-OFF TEST**

FINAL REPORT

PAGE 0012

COMPANY		LEASE/WELL			DATE					
HOECHST CELANESE		WDW 110 # 1-A			MONDAY -- OCTOBER 30, 1989					
FIELD		MEASURED AND TRUE VERTICAL TOOL DEPTHS			MID-PERF TVD AND GRADIENT					
BAY CITY PLANT		5640 FEET -- 5640 FEET			5640 FEET -- .44 PSI/FOOT					
DISC &	REAL TIME DATA	BH	BOTTOM HOLE PRESSURE			SURFACE INFORMATION				
SAMPLE	TIME	dTIME	TEMP.	PRESSURE	DELTA PRESSURE IN PSI	(t)	TUBING	WDW152	WHT	
NUMBER	HH:MM:SS	IN HOURS	(F)	IN PSI	P(o)	P (n-1)	SLOPE	IN PSI	IN PSI	DEGREES F
1- 642	18:22:00	6.5222	119.10	2574.310	-66.760	0.000	.081	1.000	1.00	1.00
1- 643	18:23:00	6.5389	119.10	2574.270	-66.800	-.040	.045	1.000	1.00	1.00
1- 644	18:24:00	6.5556	119.10	2574.280	-66.790	.010	.018	1.000	1.00	1.00
1- 645	18:25:00	6.5722	119.10	2574.240	-66.830	-.040	-.083	1.000	1.00	1.00
1- 646	18:26:00	6.5889	119.10	2574.300	-66.770	.060	-.107	1.000	1.00	1.00
1- 647	18:27:00	6.6056	119.10	2574.130	-66.940	-.170	-.229	1.000	1.00	1.00
1- 648	18:28:00	6.6222	119.10	2574.310	-66.760	.180	-.214	1.000	1.00	1.00
1- 649	18:29:00	6.6389	119.10	2574.330	-66.740	.020	-.256	1.000	1.00	1.00
1- 650	18:30:00	6.6556	119.10	2574.250	-66.820	-.080	-.281	1.000	1.00	1.00
1- 651	18:31:00	6.6722	119.10	2574.370	-66.700	.120	-.264	1.000	1.00	1.00
1- 652	18:32:00	6.6889	119.10	2574.340	-66.730	-.030	-.272	1.000	1.00	1.00
1- 653	18:33:00	6.7056	119.10	2574.250	-66.820	-.090	-.302	1.000	1.00	1.00
1- 654	18:34:00	6.7222	119.10	2574.190	-66.880	-.060	-.360	1.000	1.00	1.00
1- 655	18:35:00	6.7389	119.10	2574.270	-66.800	.080	-.355	1.000	1.00	1.00
1- 656	18:36:00	6.7556	119.10	2574.230	-66.840	-.040	-.398	1.000	1.00	1.00
1- 657	18:37:00	6.7722	119.20	2574.360	-66.710	.130	-.352	1.000	1.00	1.00
1- 658	18:38:00	6.7889	119.20	2574.240	-66.830	-.120	-.224	1.000	1.00	1.00
1- 659	18:39:00	6.8056	119.20	2574.210	-66.860	-.030	-.246	1.000	1.00	1.00
1- 660	18:40:00	6.8222	119.20	2574.270	-66.800	.060	-.205	1.000	1.00	1.00
1- 661	18:41:00	6.8389	119.20	2574.290	-66.780	.020	-.184	1.000	1.00	1.00
1- 662	18:42:00	6.8556	119.20	2574.310	-66.760	.020	-.144	1.000	1.00	1.00
1- 663	18:43:00	6.8722	119.20	2574.320	-66.750	.010	-.116	1.000	1.00	1.00
1- 664	18:44:00	6.8889	119.20	2574.300	-66.770	-.020	.002	1.000	1.00	1.00
1- 665	18:45:00	6.9056	119.20	2574.330	-66.740	.030	.043	1.000	1.00	1.00
1- 666	18:46:00	6.9222	119.20	2574.270	-66.800	-.060	.055	1.000	1.00	1.00
1- 667	18:47:00	6.9389	119.20	2574.270	-66.800	0.000	.069	1.000	1.00	1.00
1- 668	18:48:00	6.9556	119.20	2574.190	-66.880	-.080	.016	1.000	1.00	1.00
1- 669	18:49:00	6.9722	119.20	2574.310	-66.760	.120	.040	1.000	1.00	1.00
1- 670	18:50:00	6.9889	119.20	2574.210	-66.860	-.100	-.018	1.000	1.00	1.00
1- 671	18:51:00	7.0056	119.20	2574.280	-66.790	.070	.001	1.000	1.00	1.00
1- 672	18:52:00	7.0222	119.30	2574.290	-66.780	.010	-.075	1.000	1.00	1.00
1- 673	18:53:00	7.0389	119.20	2574.270	-66.800	-.020	-.062	1.000	1.00	1.00
1- 674	18:54:00	7.0556	119.20	2574.400	-66.670	.130	.036	1.000	1.00	1.00
1- 675	18:55:00	7.0722	119.30	2574.350	-66.720	-.050	.056	1.000	1.00	1.00
1- 676	18:56:00	7.0889	119.30	2574.360	-66.710	.010	.149	1.000	1.00	1.00
1- 677	18:57:00	7.1056	119.30	2574.270	-66.800	-.090	.174	1.000	1.00	1.00
1- 678	18:58:00	7.1222	119.30	2574.270	-66.800	0.000	.149	1.000	1.00	1.00
1- 679	18:59:00	7.1389	119.30	2574.210	-66.860	-.060	.054	1.000	1.00	1.00
1- 680	19:00:00	7.1556	119.30	2574.280	-66.790	.070	.044	1.000	1.00	1.00
1- 681	19:01:00	7.1722	119.30	2574.250	-66.820	-.030	-.007	1.000	1.00	1.00
1- 682	19:02:00	7.1889	119.30	2574.530	-66.540	.280	.174	1.000	1.00	1.00
1- 683	19:03:00	7.2056	119.30	2574.280	-66.790	-.250	.138	1.000	1.00	1.00
1- 684	19:04:00	7.2222	119.30	2574.260	-66.810	-.020	.070	1.000	1.00	1.00
1- 685	19:05:00	7.2389	119.30	2574.260	-66.810	0.000	.036	1.000	1.00	1.00
1- 686	19:06:00	7.2556	119.30	2574.310	-66.760	.050	.042	1.000	1.00	1.00
1- 687	19:07:00	7.2722	119.30	2574.390	-66.680	.080	.103	1.000	1.00	1.00
1- 688	19:08:00	7.2889	119.30	2574.190	-66.880	-.200	.056	1.000	1.00	1.00
1- 689	19:09:00	7.3056	119.30	2574.210	-66.860	.020	.014	1.000	1.00	1.00
1- 690	19:10:00	7.3222	119.30	2574.260	-66.810	.050	.022	1.000	1.00	1.00
1- 691	19:11:00	7.3389	119.30	2574.340	-66.730	.080	.041	1.000	1.00	1.00

\* SLOPE DEFINITION:DELTA TIME vs. PRESSURE

**GULF COAST WELL ANALYSIS**  
**FALL-OFF TEST**

FINAL REPORT

PAGE 0013

COMPANY				LEASE/WELL				DATE			
HOECHST DELANESE				MDW 110 # 1-A				MONDAY -- OCTOBER 30, 1989			
FIELD				MEASURED AND TRUE VERTICAL TOOL DEPTHS				MID-PERF TVD AND GRADIENT			
BAY CITY PLANT				5640 FEET -- 5640 FEET				5640 FEET -- .44 PSI/FOOT			
DISC #	REAL TIME DATA			BH	BOTTOM HOLE PRESSURE				SURFACE INFORMATION		
SAMPLE #	TIME	dTIME		TEMP.	PRESSURE	DELTA PRESSURE IN PSI	(s)	TUBING	MDW152	MHT	
NUMBER	HH:MM:SS	IN HOURS		(F)	IN PSI	P(n)	P (n-1)	SLOPE	IN PSI	IN PSI	DEGREES F
1- 692	19:12:00	7.3556		119.30	2574.180	-66.890	.160	-.031	1.000	1.00	1.00
1- 693	19:13:00	7.3722		119.30	2574.190	-66.880	.010	-.142	1.000	1.00	1.00
1- 694	19:14:00	7.3889		119.30	2574.220	-66.850	.030	-.164	1.000	1.00	1.00
1- 695	19:15:00	7.4056		119.40	2574.240	-66.830	.020	-.231	1.000	1.00	1.00
1- 696	19:16:00	7.4222		119.40	2574.130	-66.940	-.110	-.318	1.000	1.00	1.00
1- 697	19:17:00	7.4389		119.40	2574.280	-66.790	.150	-.310	1.000	1.00	1.00
1- 698	19:18:00	7.4556		119.40	2574.240	-66.830	-.040	-.335	1.000	1.00	1.00
1- 699	19:19:00	7.4722		119.40	2574.220	-66.850	-.020	-.291	1.000	1.00	1.00
1- 700	19:20:00	7.4889		119.40	2574.220	-66.850	0.000	-.270	1.000	1.00	1.00
1- 701	19:21:00	7.5056		119.40	2574.250	-66.820	.030	-.219	1.000	1.00	1.00
1- 702	19:22:00	7.5222		119.40	2574.210	-66.860	-.040	-.240	1.000	1.00	1.00
1- 703	19:23:00	7.5389		119.40	2574.220	-66.850	.010	-.252	1.000	1.00	1.00
1- 704	19:24:00	7.5556		119.40	2574.200	-66.870	-.020	-.310	1.000	1.00	1.00
1- 705	19:25:00	7.5722		119.40	2574.190	-66.880	-.010	-.330	1.000	1.00	1.00
1- 706	19:26:00	7.5889		119.40	2574.250	-66.820	.060	-.331	1.000	1.00	1.00
1- 707	19:28:00	7.6222		119.40	2574.200	-66.870	-.050	-.190	1.000	1.00	1.00
1- 708	19:30:00	7.6556		119.40	2574.170	-66.900	-.030	-.199	1.000	1.00	1.00
1- 709	19:32:00	7.6889		119.40	2574.170	-66.900	0.000	-.213	1.000	1.00	1.00
1- 710	19:34:00	7.7222		119.50	2574.200	-66.870	.030	-.202	1.000	1.00	1.00
1- 711	19:36:00	7.7556		119.50	2574.190	-66.880	-.010	-.169	1.000	1.00	1.00
1- 712	19:38:00	7.7889		119.50	2574.240	-66.830	.050	-.069	1.000	1.00	1.00
1- 713	19:40:00	7.8222		119.50	2574.180	-66.890	-.060	-.094	1.000	1.00	1.00
1- 714	19:42:00	7.8556		119.50	2574.170	-66.900	-.010	-.113	1.000	1.00	1.00
1- 715	19:44:00	7.8889		119.50	2574.190	-66.880	.020	-.098	1.000	1.00	1.00
1- 716	19:46:00	7.9222		119.50	2574.220	-66.850	.030	-.040	1.000	1.00	1.00
1- 717	19:48:00	7.9556		119.50	2574.210	-66.860	-.010	-.044	1.000	1.00	1.00
1- 718	19:50:00	7.9889		119.50	2574.190	-66.880	-.020	-.054	1.000	1.00	1.00
1- 719	19:52:00	8.0222		119.60	2574.230	-66.840	.040	-.038	1.000	1.00	1.00
1- 720	19:54:00	8.0556		119.50	2574.150	-66.920	-.080	-.048	1.000	1.00	1.00
1- 721	19:56:00	8.0889		119.60	2574.240	-66.830	.090	-.054	1.000	1.00	1.00
1- 722	19:58:00	8.1222		119.60	2574.200	-66.870	-.040	-.034	1.000	1.00	1.00
1- 723	20:00:00	8.1556		119.60	2574.240	-66.830	.040	-.012	1.000	1.00	1.00
1- 724	20:02:00	8.1889		119.60	2574.170	-66.900	-.070	-.019	1.000	1.00	1.00
1- 725	20:04:00	8.2222		119.60	2574.230	-66.840	.060	-.006	1.000	1.00	1.00
1- 726	20:06:00	8.2556		119.60	2574.170	-66.900	-.060	-.003	1.000	1.00	1.00
1- 727	20:08:00	8.2889		119.60	2574.150	-66.920	-.020	-.016	1.000	1.00	1.00
1- 728	20:10:00	8.3222		119.60	2574.210	-66.860	.060	-.006	1.000	1.00	1.00
1- 729	20:12:00	8.3556		119.60	2574.170	-66.900	-.040	-.014	1.000	1.00	1.00
1- 730	20:14:00	8.3889		119.60	2574.330	-66.740	.160	.021	1.000	1.00	1.00
1- 731	20:16:00	8.4222		119.70	2574.210	-66.860	-.120	.037	1.000	1.00	1.00
1- 732	20:18:00	8.4556		119.70	2574.170	-66.900	-.040	.028	1.000	1.00	1.00
1- 733	20:20:00	8.4889		119.70	2574.160	-66.910	-.010	.008	1.000	1.00	1.00
1- 734	20:22:00	8.5222		119.70	2574.340	-66.730	.180	.038	1.000	1.00	1.00
1- 735	20:24:00	8.5556		119.70	2574.170	-66.900	-.170	.026	1.000	1.00	1.00
1- 736	20:26:00	8.5889		119.70	2574.200	-66.870	.030	.020	1.000	1.00	1.00
1- 737	20:28:00	8.6222		119.70	2574.180	-66.890	-.020	.024	1.000	1.00	1.00
1- 738	20:30:00	8.6556		119.70	2574.200	-66.870	.020	.016	1.000	1.00	1.00
1- 739	20:32:00	8.6889		119.70	2574.150	-66.920	-.050	-.009	1.000	1.00	1.00
1- 740	20:34:00	8.7222		119.70	2574.120	-66.950	-.030	-.036	1.000	1.00	1.00
1- 741	20:36:00	8.7556		119.70	2574.270	-66.800	.150	-.011	1.000	1.00	1.00

\* SLOPE DEFINITION:DELTA TIME vs. PRESSURE

**GULF COAST WELL ANALYSIS**  
**FALL-OFF TEST**

FINAL REPORT

PAGE 0014

COMPANY		LEASE/WELL			DATE		
HOECHST CELANESE		WDW 110 # 1-A			MONDAY -- OCTOBER 30, 1989		
FIELD		MEASURED AND TRUE VERTICAL TOOL DEPTHS			MID-PERF TVD AND GRADIENT		
BAY CITY PLANT		5640 FEET -- 5640 FEET			5640 FEET -- .44 PSI/FOOT		
DISC #	REAL TIME DATA	BH	BOTTOM HOLE PRESSURE			SURFACE INFORMATION	
SAMPLE	TIME	dTIME	TEMP.	PRESSURE	DELTA PRESSURE IN PSI	(*)	TUBING
NUMBER	HH:MM:SS	IN HOURS	(F)	IN PSI	P(o)	P (n-1)	IN PSI
1- 742	20:38:00	8.7889	119.80	2574.280	-66.790	.010	1.000
1- 743	20:40:00	8.8222	119.80	2573.980	-67.090	-.300	1.000
1- 744	20:42:00	8.8556	119.80	2574.060	-67.010	.080	1.000
1- 745	20:44:00	8.8889	119.80	2574.160	-66.910	.100	1.000
1- 746	20:46:00	8.9222	119.80	2574.180	-66.890	.020	1.000
1- 747	20:48:00	8.9556	119.80	2574.170	-66.900	-.010	1.000
1- 748	20:50:00	8.9889	119.80	2574.160	-66.910	-.010	1.000
1- 749	20:52:00	9.0222	119.80	2574.130	-66.940	-.030	1.000
1- 750	20:54:00	9.0556	119.80	2574.180	-66.890	.050	1.000
1- 751	20:56:00	9.0889	119.80	2574.140	-66.930	-.040	1.000
1- 752	20:58:00	9.1222	119.80	2574.170	-66.900	.030	1.000
1- 753	21:00:00	9.1556	119.90	2574.030	-67.040	-.140	1.000
1- 754	21:02:00	9.1889	119.90	2574.040	-67.030	.010	1.000
1- 755	21:04:00	9.2222	119.90	2574.070	-67.000	.030	1.000
1- 756	21:06:00	9.2556	119.90	2574.020	-67.050	-.050	1.000
1- 757	21:08:00	9.2889	119.90	2574.060	-67.010	.040	1.000
1- 758	21:10:00	9.3222	119.90	2574.040	-67.030	-.020	1.000
1- 759	21:12:00	9.3556	119.90	2574.130	-66.940	.090	1.000
1- 760	21:14:00	9.3889	119.90	2574.010	-67.060	-.120	1.000
1- 761	21:16:00	9.4222	119.90	2574.080	-66.990	.070	1.000
1- 762	21:18:00	9.4556	119.90	2574.210	-66.860	.130	1.000
1- 763	21:20:00	9.4889	119.90	2574.040	-67.030	-.170	1.000
1- 764	21:22:00	9.5222	119.90	2574.170	-66.900	.130	1.000
1- 765	21:24:00	9.5556	120.00	2574.160	-66.910	-.010	1.000
1- 766	21:26:00	9.5889	120.00	2574.140	-66.930	-.020	1.000
1- 767	21:28:00	9.6222	120.00	2574.110	-66.960	-.030	1.000
1- 768	21:30:00	9.6556	120.00	2574.100	-66.970	-.010	1.000
1- 769	21:32:00	9.6889	120.00	2574.130	-66.940	.030	1.000
1- 770	21:34:00	9.7222	120.00	2574.310	-66.760	.180	1.000
1- 771	21:36:00	9.7556	120.00	2574.090	-66.980	-.220	1.000
1- 772	21:38:00	9.7889	120.00	2574.080	-66.990	-.010	1.000
1- 773	21:40:00	9.8222	120.00	2574.120	-66.950	.040	1.000
1- 774	21:42:00	9.8556	120.00	2574.110	-66.960	-.010	1.000
1- 775	21:44:00	9.8889	120.00	2574.110	-66.960	0.000	1.000
1- 776	21:46:00	9.9222	120.10	2574.050	-67.020	-.060	1.000
1- 777	21:48:00	9.9556	120.10	2574.090	-66.980	.040	1.000
1- 778	21:50:00	9.9889	120.10	2573.990	-67.080	-.100	1.000
1- 779	21:52:00	10.0222	120.10	2574.100	-66.970	.110	1.000
1- 780	21:54:00	10.0556	120.10	2574.150	-66.920	.050	1.000
1- 781	21:56:00	10.0889	120.10	2574.050	-67.020	-.100	1.000
1- 782	21:58:00	10.1222	120.10	2574.090	-66.980	.040	1.000
1- 783	22:00:00	10.1556	120.10	2573.920	-67.150	-.170	1.000
1- 784	22:02:00	10.1889	120.10	2574.090	-66.980	.170	1.000
1- 785	22:04:00	10.2222	120.10	2574.150	-66.920	.060	1.000
1- 786	22:06:00	10.2556	120.10	2574.020	-67.050	-.130	1.000
1- 787	22:08:00	10.2889	120.10	2574.000	-67.070	-.020	1.000
1- 788	22:10:00	10.3222	120.20	2574.000	-67.070	0.000	1.000
1- 789	22:12:00	10.3556	120.20	2574.260	-66.810	.260	1.000
1- 790	22:14:00	10.3889	120.20	2573.990	-67.080	-.270	1.000
1- 791	22:16:00	10.4222	120.20	2574.060	-67.010	.070	1.000

\* SLOPE DEFINITION: DELTA TIME vs. PRESSURE

**GULF COAST WELL ANALYSIS**  
**FALL-OFF TEST**

FINAL REPORT

PAGE 0015

COMPANY		LEASE/WELL				DATE				
HOECHST CELANESE		MDW 110 # 1-A				MONDAY -- OCTOBER 30, 1989				
FIELD		MEASURED AND TRUE VERTICAL TOOL DEPTHS				MID-PERF TVD AND GRADIENT				
BAY CITY PLANT		5640 FEET -- 5640 FEET				5640 FEET -- .44 PSI/FOOT				
DISC #	REAL TIME DATA	BH	BOTTOM HOLE PRESSURE				SURFACE INFORMATION			
SAMPLE NUMBER	TIME HH:MM:SS	IN HOURS	TEMP. (F)	PRESSURE IN PSI	DELTA PRESSURE IN PSI P(o)	P (n-1)	SLOPE	TUBING IN PSI	MDW152 MHT IN PSI	
1- 792	22:18:00	10.4556	120.20	2574.090	-66.980	.030	-.106	1.000	1.00	1.00
1- 793	22:20:00	10.4889	120.20	2574.030	-67.040	-.060	-.117	1.000	1.00	1.00
1- 794	22:22:00	10.5222	120.20	2574.060	-67.010	.030	-.109	1.000	1.00	1.00
1- 795	22:24:00	10.5556	120.20	2574.020	-67.050	-.040	-.057	1.000	1.00	1.00
1- 796	22:26:00	10.5889	120.20	2574.050	-67.020	.030	-.056	1.000	1.00	1.00
1- 797	22:28:00	10.6222	120.20	2574.150	-66.920	.100	-.029	1.000	1.00	1.00
1- 798	22:30:00	10.6556	120.20	2573.990	-67.080	-.160	-.036	1.000	1.00	1.00
1- 799	22:32:00	10.6889	120.20	2574.000	-67.070	.010	-.041	1.000	1.00	1.00
1- 800	22:34:00	10.7222	120.20	2574.000	-67.070	0.000	-.043	1.000	1.00	1.00
1- 801	22:36:00	10.7556	120.20	2573.880	-67.190	-.120	-.093	1.000	1.00	1.00
1- 802	22:38:00	10.7889	120.20	2573.980	-67.090	.100	-.100	1.000	1.00	1.00
1- 803	22:40:00	10.8222	120.30	2574.030	-67.040	.050	-.121	1.000	1.00	1.00
1- 804	22:42:00	10.8556	120.30	2573.990	-67.080	-.040	-.120	1.000	1.00	1.00
1- 805	22:44:00	10.8889	120.30	2574.020	-67.050	.030	-.094	1.000	1.00	1.00
1- 806	22:46:00	10.9222	120.30	2574.030	-67.040	.010	-.092	1.000	1.00	1.00
1- 807	22:48:00	10.9556	120.30	2573.980	-67.090	-.050	-.091	1.000	1.00	1.00
1- 808	22:50:00	10.9889	120.30	2573.950	-67.120	-.030	-.147	1.000	1.00	1.00
1- 809	22:52:00	11.0222	120.30	2574.030	-67.040	.080	-.131	1.000	1.00	1.00
1- 810	22:54:00	11.0556	120.30	2573.990	-67.080	-.040	-.106	1.000	1.00	1.00
1- 811	22:56:00	11.0889	120.30	2573.930	-67.140	-.050	-.133	1.000	1.00	1.00
1- 812	22:58:00	11.1222	120.30	2573.930	-67.140	0.000	-.165	1.000	1.00	1.00
1- 813	23:00:00	11.1556	120.30	2574.020	-67.050	.090	-.169	1.000	1.00	1.00
1- 814	23:02:00	11.1889	120.30	2573.950	-67.120	-.070	-.116	1.000	1.00	1.00
1- 815	23:04:00	11.2222	120.30	2573.980	-67.090	.030	-.128	1.000	1.00	1.00
1- 816	23:06:00	11.2556	120.40	2573.900	-67.170	-.080	-.141	1.000	1.00	1.00
1- 817	23:08:00	11.2889	120.40	2573.960	-67.110	.060	-.124	1.000	1.00	1.00
1- 818	23:10:00	11.3222	120.40	2574.110	-66.960	.150	-.081	1.000	1.00	1.00
1- 819	23:12:00	11.3556	120.40	2574.020	-67.050	-.090	-.056	1.000	1.00	1.00
1- 820	23:14:00	11.3889	120.40	2574.000	-67.070	-.020	-.048	1.000	1.00	1.00
1- 821	23:16:00	11.4222	120.40	2573.800	-67.270	-.200	-.085	1.000	1.00	1.00
1- 822	23:18:00	11.4556	120.40	2573.950	-67.120	.150	-.045	1.000	1.00	1.00
1- 823	23:20:00	11.4889	120.40	2573.970	-67.100	.020	-.043	1.000	1.00	1.00
1- 824	23:22:00	11.5222	120.40	2573.940	-67.130	-.030	-.046	1.000	1.00	1.00
1- 825	23:24:00	11.5556	120.40	2573.970	-67.100	.030	-.039	1.000	1.00	1.00
1- 826	23:26:00	11.5889	120.40	2573.920	-67.150	-.050	-.081	1.000	1.00	1.00
1- 827	23:28:00	11.6222	120.40	2573.950	-67.120	.030	-.086	1.000	1.00	1.00
1- 828	23:30:00	11.6556	120.40	2574.110	-66.960	.160	-.031	1.000	1.00	1.00
1- 829	23:32:00	11.6889	120.50	2574.040	-67.030	-.070	-.009	1.000	1.00	1.00
1- 830	23:34:00	11.7222	120.50	2573.980	-67.090	-.060	-.004	1.000	1.00	1.00
1- 831	23:36:00	11.7556	120.50	2573.960	-67.110	-.020	.016	1.000	1.00	1.00
1- 832	23:38:00	11.7889	120.50	2573.950	-67.120	-.010	.011	1.000	1.00	1.00
1- 833	23:40:00	11.8222	120.50	2573.880	-67.190	-.070	-.021	1.000	1.00	1.00
1- 834	23:42:00	11.8556	120.50	2573.940	-67.130	.060	-.011	1.000	1.00	1.00
1- 835	23:44:00	11.8889	120.50	2573.890	-67.180	-.050	-.025	1.000	1.00	1.00
1- 836	23:46:00	11.9222	120.50	2573.940	-67.130	.050	-.041	1.000	1.00	1.00
1- 837	23:48:00	11.9556	120.50	2574.040	-67.030	.100	-.029	1.000	1.00	1.00
1- 838	23:50:00	11.9889	120.50	2573.940	-67.130	-.100	-.020	1.000	1.00	1.00
1- 839	23:52:00	12.0222	120.50	2573.930	-67.140	-.010	-.034	1.000	1.00	1.00
1- 840	23:54:00	12.0556	120.50	2573.860	-67.210	-.070	-.057	1.000	1.00	1.00
1- 841	23:56:00	12.0889	120.50	2573.930	-67.140	.070	-.082	1.000	1.00	1.00

\* SLOPE DEFINITION: DELTA TIME vs. PRESSURE

**GULF COAST WELL ANALYSIS**  
**FALL-OFF TEST**

FINAL REPORT

PAGE 0016

COMPANY				LEASE/WELL				DATE			
HOECHST CELANESE				WDW 110 # 1-A				MONDAY -- OCTOBER 30, 1989			
FIELD				MEASURED AND TRUE VERTICAL TOOL DEPTHS				MID-PERF TVD AND GRADIENT			
BAY CITY PLANT				5640 FEET -- 5640 FEET				5640 FEET -- .44 PSI/FOOT			
DISC #	REAL TIME DATA	BH		BOTTOM HOLE PRESSURE				SURFACE INFORMATION			
SAMPLE NUMBER	TIME HH:MM:SS	IN HOURS	dTIME (F)	TEMP. (F)	PRESSURE IN PSI	DELTA PRESSURE IN PSI P(o)	P (n-1)	SLOPE	TUBING IN PSI	WDW152 IN PSI	WHT DEGREES F
1- 842	23:58:00	12.1222	120.60	2573.960	-67.110	.030	-.082	1.000	1.00	1.00	
1- 843	00:00:00	12.1556	120.60	2573.960	-67.110	0.000	-.036	1.000	1.00	1.00	
1- 844	00:02:00	12.1889	120.60	2573.990	-67.080	.030	-.006	1.000	1.00	1.00	
1- 845	00:04:00	12.2222	120.60	2573.930	-67.140	-.060	.002	1.000	1.00	1.00	
1- 846	00:06:00	12.2556	120.60	2573.990	-67.080	.060	-.031	1.000	1.00	1.00	
1- 847	00:08:00	12.2889	120.60	2573.970	-67.100	-.020	-.030	1.000	1.00	1.00	
1- 848	00:10:00	12.3222	120.60	2573.900	-67.170	-.070	-.042	1.000	1.00	1.00	
1- 849	00:12:00	12.3556	120.60	2573.920	-67.150	.020	-.056	1.000	1.00	1.00	
1- 850	00:14:00	12.3889	120.60	2573.880	-67.190	-.040	-.072	1.000	1.00	1.00	
1- 851	00:16:00	12.4222	120.60	2573.980	-67.090	.100	-.072	1.000	1.00	1.00	
1- 852	00:18:00	12.4556	120.60	2573.900	-67.170	-.080	-.088	1.000	1.00	1.00	
1- 853	00:20:00	12.4889	120.60	2573.870	-67.200	-.030	-.063	1.000	1.00	1.00	
1- 854	00:22:00	12.5222	120.60	2573.950	-67.120	.080	-.030	1.000	1.00	1.00	
1- 855	00:24:00	12.5556	120.60	2573.880	-67.190	-.070	-.034	1.000	1.00	1.00	
1- 856	00:26:00	12.5889	120.60	2573.860	-67.210	-.020	-.046	1.000	1.00	1.00	
1- 857	00:28:00	12.6222	120.60	2573.870	-67.200	.010	-.057	1.000	1.00	1.00	
1- 858	00:30:00	12.6556	120.60	2573.870	-67.200	0.000	-.086	1.000	1.00	1.00	
1- 859	00:32:00	12.6889	120.60	2573.900	-67.170	.030	-.089	1.000	1.00	1.00	
1- 860	00:34:00	12.7222	120.70	2573.880	-67.190	-.020	-.112	1.000	1.00	1.00	
1- 861	00:36:00	12.7556	120.70	2573.870	-67.200	-.010	-.122	1.000	1.00	1.00	
1- 862	00:38:00	12.7889	120.70	2573.870	-67.200	0.000	-.100	1.000	1.00	1.00	
1- 863	00:40:00	12.8222	120.70	2573.840	-67.230	-.030	-.113	1.000	1.00	1.00	
1- 864	00:42:00	12.8556	120.70	2573.870	-67.200	.030	-.119	1.000	1.00	1.00	
1- 865	00:44:00	12.8889	120.70	2573.890	-67.180	-.020	-.138	1.000	1.00	1.00	
1- 866	00:46:00	12.9222	120.70	2573.870	-67.240	-.060	-.154	1.000	1.00	1.00	
1- 867	00:48:00	12.9556	120.70	2573.900	-67.170	.070	-.139	1.000	1.00	1.00	
1- 868	00:50:00	12.9889	120.70	2573.860	-67.210	-.040	-.133	1.000	1.00	1.00	
1- 869	00:52:00	13.0222	120.70	2573.880	-67.190	.020	-.111	1.000	1.00	1.00	
1- 870	00:54:00	13.0556	120.70	2573.960	-67.110	.080	-.082	1.000	1.00	1.00	
1- 871	00:56:00	13.0889	120.80	2573.820	-67.250	-.140	-.075	1.000	1.00	1.00	
1- 872	00:58:00	13.1222	120.70	2573.840	-67.230	.020	-.084	1.000	1.00	1.00	
1- 873	01:00:00	13.1556	120.80	2573.860	-67.210	.020	-.066	1.000	1.00	1.00	
1- 874	01:02:00	13.1889	120.70	2573.860	-67.210	0.000	-.060	1.000	1.00	1.00	
1- 875	01:04:00	13.2222	120.80	2573.840	-67.230	-.020	-.071	1.000	1.00	1.00	
1- 876	01:06:00	13.2556	120.80	2573.900	-67.170	.060	-.035	1.000	1.00	1.00	
1- 877	01:08:00	13.2889	120.80	2573.870	-67.200	-.030	-.028	1.000	1.00	1.00	
1- 878	01:10:00	13.3222	120.80	2573.760	-67.310	-.110	-.061	1.000	1.00	1.00	
1- 879	01:12:00	13.3556	120.80	2573.840	-67.230	.080	-.045	1.000	1.00	1.00	
1- 880	01:14:00	13.3889	120.80	2573.890	-67.180	.050	-.033	1.000	1.00	1.00	
1- 881	01:16:00	13.4222	120.80	2573.820	-67.250	-.070	-.047	1.000	1.00	1.00	
1- 882	01:18:00	13.4556	120.80	2573.840	-67.230	.020	-.052	1.000	1.00	1.00	
1- 883	01:20:00	13.4889	120.80	2573.800	-67.270	-.040	-.067	1.000	1.00	1.00	
1- 884	01:22:00	13.5222	120.80	2573.830	-67.240	.030	-.063	1.000	1.00	1.00	
1- 885	01:24:00	13.5556	120.80	2573.800	-67.270	-.030	-.072	1.000	1.00	1.00	
1- 886	01:26:00	13.5889	120.80	2573.840	-67.230	.040	-.071	1.000	1.00	1.00	
1- 887	01:28:00	13.6222	120.80	2573.880	-67.190	.040	-.058	1.000	1.00	1.00	
1- 888	01:30:00	13.6556	120.80	2573.900	-67.170	.020	-.048	1.000	1.00	1.00	
1- 889	01:32:00	13.6889	120.80	2573.840	-67.230	-.060	-.048	1.000	1.00	1.00	
1- 890	01:34:00	13.7222	120.90	2573.900	-67.170	.060	-.025	1.000	1.00	1.00	
1- 891	01:36:00	13.7556	120.90	2573.820	-67.250	-.080	-.042	1.000	1.00	1.00	

\* SLOPE DEFINITION: DELTA TIME vs. PRESSURE

**GULF COAST WELL ANALYSIS**  
**FALL-OFF TEST**

FINAL REPORT

PAGE 0017

COMPANY			LEASE/WELL			DATE		
HOECHST CELANESE			MDW 110 # 1-A			TUESDAY -- OCTOBER 31, 1989		
FIELD			MEASURED AND TRUE VERTICAL TOOL DEPTHS			MID-PERF TVD AND GRADIENT		
BAY CITY PLANT			5640 FEET -- 5640 FEET			5640 FEET -- .44 PSI/FOOT		
DISC &	REAL TIME DATA	BH	BOTTOM HOLE PRESSURE			SURFACE INFORMATION		
SAMPLE	TIME	dTIME	TEMP.	PRESSURE	DELTA PRESSURE IN PSI	( $\Delta$ )	TUBING	MDW152
NUMBER	HH:MM:SS	IN HOURS	(F)	IN PSI	P( $\sigma$ )	P ( $n-1$ )	IN PSI	IN PSI
1- 892	01:38:00	13.7889	120.90	2573.830	-67.240	.010	-.034	1.000
1- 893	01:40:00	13.8222	120.90	2573.760	-67.310	-.070	-.057	1.000
1- 894	01:42:00	13.8556	120.90	2573.830	-67.240	.070	-.052	1.000
1- 895	01:44:00	13.8889	120.90	2573.830	-67.240	0.000	-.022	1.000
1- 896	01:46:00	13.9222	120.90	2573.870	-67.290	.040	-.019	1.000
1- 897	01:48:00	13.9556	120.90	2573.850	-67.220	-.020	-.018	1.000
1- 898	01:50:00	13.9889	120.90	2573.850	-67.220	0.000	-.010	1.000
1- 899	01:52:00	14.0222	120.90	2573.840	-67.230	-.010	-.006	1.000
1- 900	01:54:00	14.0556	120.90	2573.820	-67.250	-.020	-.012	1.000
1- 901	01:56:00	14.0889	120.90	2573.850	-67.220	.030	.009	1.000
1- 902	01:58:00	14.1222	120.90	2573.830	-67.240	-.020	.016	1.000
1- 903	02:00:00	14.1556	120.90	2573.850	-67.220	.020	-.003	1.000
1- 904	02:02:00	14.1889	120.90	2573.840	-67.230	-.010	-.004	1.000
1- 905	02:04:00	14.2222	120.90	2573.800	-67.270	-.040	-.000	1.000
1- 906	02:06:00	14.2556	120.90	2573.890	-67.180	.090	.010	1.000
1- 907	02:08:00	14.2889	121.00	2573.820	-67.250	-.070	.004	1.000
1- 908	02:10:00	14.3222	121.00	2573.900	-67.170	.080	.010	1.000
1- 909	02:12:00	14.3556	121.00	2573.800	-67.270	-.100	-.006	1.000
1- 910	02:14:00	14.3889	121.00	2573.830	-67.240	.030	-.022	1.000
1- 911	02:16:00	14.4222	121.00	2573.850	-67.220	.020	-.021	1.000
1- 912	02:18:00	14.4556	121.00	2573.790	-67.280	-.060	-.024	1.000
1- 913	02:20:00	14.4889	121.00	2573.690	-67.380	-.100	-.048	1.000
1- 914	02:22:00	14.5222	121.00	2573.760	-67.310	.070	-.065	1.000
1- 915	02:24:00	14.5556	121.00	2573.820	-67.250	.060	-.045	1.000
1- 916	02:26:00	14.5889	121.00	2573.840	-67.230	.020	-.042	1.000
1- 917	02:28:00	14.6222	121.00	2573.720	-67.350	-.120	-.070	1.000
1- 918	02:30:00	14.6556	121.00	2573.910	-67.160	.190	-.064	1.000
1- 919	02:32:00	14.6889	121.00	2573.880	-67.190	-.030	-.049	1.000
1- 920	02:34:00	14.7222	121.00	2573.840	-67.230	-.040	-.045	1.000
1- 921	02:36:00	14.7556	121.00	2573.740	-67.310	-.080	-.053	1.000
1- 922	02:38:00	14.7889	121.00	2573.840	-67.230	.080	-.041	1.000
1- 923	02:40:00	14.8222	121.00	2573.670	-67.400	-.170	-.076	1.000
1- 924	02:42:00	14.8556	121.00	2573.810	-67.260	.140	-.072	1.000
1- 925	02:44:00	14.8889	121.10	2573.730	-67.340	-.080	-.095	1.000
1- 926	02:46:00	14.9222	121.10	2573.740	-67.330	.010	-.104	1.000
1- 927	02:48:00	14.9556	121.10	2573.900	-67.170	.160	-.072	1.000
1- 928	02:50:00	14.9889	121.10	2573.710	-67.360	-.190	-.088	1.000
1- 929	02:52:00	15.0222	121.10	2573.780	-67.290	.070	-.085	1.000
1- 930	02:54:00	15.0556	121.10	2573.840	-67.230	.060	-.076	1.000
1- 931	02:56:00	15.0889	121.10	2573.830	-67.240	-.010	-.043	1.000
1- 932	02:58:00	15.1222	121.10	2573.820	-67.250	-.010	-.033	1.000
1- 933	03:00:00	15.1556	121.10	2573.850	-67.220	.030	.009	1.000
1- 934	03:02:00	15.1889	121.10	2573.830	-67.240	-.020	.018	1.000
1- 935	03:04:00	15.2222	121.10	2573.810	-67.260	-.020	.028	1.000
1- 936	03:06:00	15.2556	121.10	2573.790	-67.280	-.020	.040	1.000
1- 937	03:08:00	15.2889	121.10	2573.780	-67.290	-.010	.033	1.000
1- 938	03:10:00	15.3222	121.10	2573.740	-67.330	-.040	-.016	1.000
1- 939	03:12:00	15.3556	121.10	2573.860	-67.210	.120	-.011	1.000
1- 940	03:14:00	15.3889	121.10	2573.790	-67.280	-.070	-.010	1.000
1- 941	03:16:00	15.4222	121.10	2573.790	-67.280	0.000	-.003	1.000

\* SLOPE DEFINITION: DELTA TIME vs. PRESSURE

**GULF COAST WELL ANALYSIS**  
**FALL-OFF TEST**

FINAL REPORT

PAGE 0018

COMPANY		LEASE/WELL				DATE			
HOECHST CELANESE		WDW 110 # 1-A				TUESDAY -- OCTOBER 31, 1989			
FIELD		MEASURED AND TRUE VERTICAL TOOL DEPTHS				MID-PERF TVD AND GRADIENT			
BAY CITY PLANT		5640 FEET -- 5640 FEET				5640 FEET -- .44 PSI/FOOT			
DISC #	REAL TIME DATA	BH	BOTTOM HOLE PRESSURE				SURFACE INFORMATION		
SAMPLE	TIME	dTIME	TEMP.	PRESSURE	DELTA PRESSURE IN PSI	(*)	TUBING	WDW152	WHT
NUMBER	HH:MM:SS	IN HOURS	(F)	IN PSI	P(n)	P (n-1)	SLOPE	IN PSI	IN PSI
1- 942	03:18:00	15.4556	121.20	2573.770	-67.300	-.020	-.036	1.000	1.00
1- 943	03:20:00	15.4889	121.20	2573.780	-67.290	.010	-.010	1.000	1.00
1- 944	03:22:00	15.5222	121.20	2573.840	-67.230	.060	.027	1.000	1.00
1- 945	03:24:00	15.5556	121.20	2573.750	-67.320	-.090	.027	1.000	1.00
1- 946	03:26:00	15.5889	121.20	2573.780	-67.290	.030	.014	1.000	1.00
1- 947	03:28:00	15.6222	121.20	2573.810	-67.260	.030	.033	1.000	1.00
1- 948	03:30:00	15.6556	121.20	2573.750	-67.320	-.060	-.015	1.000	1.00
1- 949	03:32:00	15.6889	121.20	2573.800	-67.270	.050	-.010	1.000	1.00
1- 950	03:34:00	15.7222	121.20	2573.750	-67.320	-.050	-.042	1.000	1.00
1- 951	03:36:00	15.7556	121.20	2573.820	-67.250	.070	-.051	1.000	1.00
1- 952	03:38:00	15.7889	121.20	2573.750	-67.320	-.070	-.035	1.000	1.00
1- 953	03:40:00	15.8222	121.20	2573.640	-67.430	-.110	-.102	1.000	1.00
1- 954	03:42:00	15.8556	121.20	2573.830	-67.240	.190	-.094	1.000	1.00
1- 955	03:44:00	15.8889	121.20	2573.880	-67.190	.050	-.055	1.000	1.00
1- 956	03:46:00	15.9222	121.20	2573.720	-67.350	-.160	-.064	1.000	1.00
1- 957	03:48:00	15.9556	121.20	2573.710	-67.360	-.010	-.077	1.000	1.00
1- 958	03:50:00	15.9889	121.20	2573.780	-67.290	.070	-.059	1.000	1.00
1- 959	03:52:00	16.0222	121.20	2573.820	-67.250	.040	-.034	1.000	1.00
1- 960	03:54:00	16.0556	121.20	2573.730	-67.340	-.090	-.040	1.000	1.00
1- 961	03:56:00	16.0889	121.30	2573.810	-67.260	.080	-.027	1.000	1.00
1- 962	03:58:00	16.1222	121.30	2573.790	-67.280	-.020	-.024	1.000	1.00
1- 963	04:00:00	16.1556	121.30	2573.820	-67.250	.030	-.025	1.000	1.00
1- 964	04:02:00	16.1889	121.30	2573.850	-67.220	.030	.017	1.000	1.00
1- 965	04:04:00	16.2222	121.30	2573.810	-67.260	-.040	.027	1.000	1.00
1- 966	04:06:00	16.2556	121.30	2573.830	-67.240	.020	.042	1.000	1.00
1- 967	04:08:00	16.2889	121.30	2573.800	-67.270	-.030	.042	1.000	1.00
1- 968	04:10:00	16.3222	121.30	2573.830	-67.240	.030	.052	1.000	1.00
1- 969	04:12:00	16.3556	121.30	2573.830	-67.240	0.000	.079	1.000	1.00
1- 970	04:14:00	16.3889	121.30	2573.740	-67.330	-.090	.055	1.000	1.00
1- 971	04:16:00	16.4222	121.30	2573.770	-67.300	.030	.048	1.000	1.00
1- 972	04:18:00	16.4556	121.30	2573.790	-67.280	.020	.056	1.000	1.00
1- 973	04:20:00	16.4889	121.30	2573.850	-67.220	.060	.063	1.000	1.00
1- 974	04:22:00	16.5222	121.30	2573.780	-67.290	-.070	.063	1.000	1.00
1- 975	04:24:00	16.5556	121.30	2573.820	-67.250	.040	.060	1.000	1.00
1- 976	04:26:00	16.5889	121.30	2573.860	-67.210	.040	.087	1.000	1.00
1- 977	04:28:00	16.6222	121.30	2573.750	-67.320	-.110	.062	1.000	1.00
1- 978	04:30:00	16.6556	121.30	2573.750	-67.320	0.000	.003	1.000	1.00
1- 979	04:32:00	16.6889	121.30	2573.760	-67.310	.010	.003	1.000	1.00
1- 980	04:34:00	16.7222	121.30	2573.750	-67.320	-.010	.015	1.000	1.00
1- 981	04:36:00	16.7556	121.40	2573.790	-67.280	.040	-.006	1.000	1.00
1- 982	04:38:00	16.7889	121.30	2573.730	-67.340	-.060	-.048	1.000	1.00
1- 983	04:40:00	16.8222	121.40	2573.710	-67.360	-.020	-.075	1.000	1.00
1- 984	04:42:00	16.8556	121.40	2573.720	-67.350	.010	-.086	1.000	1.00
1- 985	04:44:00	16.8889	121.40	2573.760	-67.310	.040	-.110	1.000	1.00
1- 986	04:46:00	16.9222	121.40	2573.760	-67.310	0.000	-.111	1.000	1.00
1- 987	04:48:00	16.9556	121.40	2573.690	-67.380	-.070	-.137	1.000	1.00
1- 988	04:50:00	16.9889	121.40	2573.800	-67.270	.110	-.120	1.000	1.00
1- 989	04:52:00	17.0222	121.40	2573.810	-67.260	.010	-.092	1.000	1.00
1- 990	04:54:00	17.0556	121.40	2573.780	-67.290	-.030	-.083	1.000	1.00
1- 991	04:56:00	17.0889	121.40	2573.770	-67.300	-.010	-.069	1.000	1.00

\* SLOPE DEFINITION:DELTA TIME vs. PRESSURE

**GULF COAST WELL ANALYSIS**  
**FALL-OFF TEST**

FINAL REPORT

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COMPANY		LEASE/WELL			DATE		
HOECHST CELANESE		WDW 110 # 1-A			TUESDAY -- OCTOBER 31, 1989		
FIELD		MEASURED AND TRUE VERTICAL TOOL DEPTHS			MID-PERF TVD AND GRADIENT		
BAY CITY PLANT		5640 FEET -- 5640 FEET			5640 FEET -- .44 PSI/FOOT		
DISC #	REAL TIME DATA	BH	BOTTOM HOLE PRESSURE			SURFACE INFORMATION	
SAMPLE	TIME	dTIME	TEMP.	PRESSURE	DELTA PRESSURE IN PSI	(S)	TUBING
NUMBER	HH:MM:SS	IN HOURS	(F)	IN PSI	P(n)	P (n-1)	WDW152
1- 992	04:58:00	17.1222	121.40	2573.770	-67.300	0.000	1.000
1- 993	05:00:00	17.1556	121.40	2573.780	-67.290	.010	-0.046
1- 994	05:02:00	17.1889	121.40	2573.800	-67.270	.020	-0.021
1- 995	05:04:00	17.2222	121.40	2573.740	-67.330	-.060	-0.039
1- 996	05:06:00	17.2556	121.40	2573.770	-67.300	.030	-0.040
1- 997	05:08:00	17.2889	121.40	2573.790	-67.280	.020	-0.030
1- 998	05:10:00	17.3222	121.40	2573.770	-67.300	-.020	-0.007
1- 999	05:12:00	17.3556	121.40	2573.780	-67.290	.010	-0.000
1-1000	05:14:00	17.3889	121.40	2573.710	-67.360	-.070	-0.001
1-1001	05:16:00	17.4222	121.50	2573.910	-67.160	.200	.069
1-1002	05:18:00	17.4556	121.40	2573.740	-67.330	-.170	.057
1-1003	05:20:00	17.4889	121.50	2573.750	-67.320	.010	.048
1-1004	05:22:00	17.5222	121.50	2573.770	-67.300	.020	.047
1-1005	05:24:00	17.5556	121.50	2573.740	-67.330	-.030	.035
1-1006	05:26:00	17.5889	121.50	2573.720	-67.350	-.020	.030
1-1007	05:28:00	17.6222	121.50	2573.800	-67.270	.080	.030
1-1008	05:30:00	17.6556	121.50	2573.740	-67.330	-.060	.006
1-1009	05:32:00	17.6889	121.50	2573.780	-67.290	.040	-.004
1-1010	05:34:00	17.7222	121.50	2573.720	-67.350	-.060	-.020
1-1011	05:36:00	17.7556	121.50	2573.820	-67.250	.100	-.008
1-1012	05:38:00	17.7889	121.50	2573.690	-67.380	-.130	-.054
1-1013	05:40:00	17.8222	121.50	2573.750	-67.320	.060	-.051
1-1014	05:42:00	17.8556	121.50	2573.720	-67.350	-.030	-.051
1-1015	05:44:00	17.8889	121.50	2573.740	-67.330	.020	-.054
1-1016	05:46:00	17.9222	121.50	2573.790	-67.280	.050	-.044
1-1017	05:48:00	17.9556	121.50	2573.740	-67.330	-.050	-.048
1-1018	05:50:00	17.9889	121.50	2573.700	-67.370	-.040	-.060
1-1019	05:52:00	18.0222	121.50	2573.760	-67.310	.060	-.048
1-1020	05:54:00	18.0556	121.50	2573.730	-67.340	-.030	-.061
1-1021	05:56:00	18.0889	121.50	2573.760	-67.310	.030	-.056
1-1022	05:58:00	18.1222	121.50	2573.760	-67.310	0.000	-.045
1-1023	06:00:00	18.1556	121.50	2573.680	-67.390	-.080	-.062
1-1024	06:02:00	18.1889	121.60	2573.730	-67.340	.050	-.060
1-1025	06:04:00	18.2222	121.60	2573.740	-67.330	.010	-.075
1-1026	06:06:00	18.2556	121.60	2573.720	-67.350	-.020	-.036
1-1027	06:08:00	18.2889	121.60	2573.650	-67.420	-.070	-.063
1-1028	06:10:00	18.3222	121.60	2573.670	-67.400	.020	-.079
1-1029	06:12:00	18.3556	121.60	2573.720	-67.350	.050	-.074
1-1030	06:14:00	18.3889	121.60	2573.660	-67.410	-.060	-.093
1-1031	06:16:00	18.4222	121.60	2573.750	-67.320	.090	-.091
1-1032	06:18:00	18.4556	121.60	2573.740	-67.330	-.010	-.069
1-1033	06:20:00	18.4889	121.60	2573.670	-67.400	-.070	-.083
1-1034	06:22:00	18.5222	121.60	2573.750	-67.320	.080	-.061
1-1035	06:24:00	18.5556	121.60	2573.760	-67.310	.010	-.054
1-1036	06:26:00	18.5889	121.60	2573.650	-67.420	-.110	-.048
1-1037	06:28:00	18.6222	121.60	2573.810	-67.260	.160	-.032
1-1038	06:30:00	18.6556	121.60	2573.750	-67.320	-.060	-.018
1-1039	06:32:00	18.6889	121.60	2573.740	-67.330	-.010	-.016
1-1040	06:34:00	18.7222	121.60	2573.700	-67.370	-.040	-.020
1-1041	06:36:00	18.7556	121.60	2573.690	-67.380	-.010	-.010

\* SLOPE DEFINITION: DELTA TIME vs. PRESSURE

**GULF COAST WELL ANALYSIS**  
**FALL-OFF TEST**

FINAL REPORT

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COMPANY			LEASE/WELL			DATE			
HOECHST CELANESE			MDW 110 # 1-A			TUESDAY -- OCTOBER 31, 1989			
FIELD			MEASURED AND TRUE VERTICAL TOOL DEPTHS			MID-PERF TVD AND GRADIENT			
BAY CITY PLANT			5640 FEET -- 5640 FEET			5640 FEET -- .44 PSI/FOOT			
DISC &	REAL TIME DATA	BH	BOTTOM HOLE PRESSURE			SURFACE INFORMATION			
SAMPLE	TIME	dTIME	TEMP.	PRESSURE	DELTA PRESSURE IN PSI	(*)	TUBING	MDW152	MHT
NUMBER	HH:MM:SS	IN HOURS	(F)	IN PSI	P(n)	P(n-1)	IN PSI	IN PSI	DEGREES F
1-1042	06:38:00	18.7889	121.60	2573.750	-67.320	.060	.003	1.000	1.00
1-1043	06:40:00	18.8222	121.60	2573.680	-67.390	-.070	-.015	1.000	1.00
1-1044	06:42:00	18.8556	121.60	2573.740	-67.330	.060	.003	1.000	1.00
1-1045	06:44:00	18.8889	121.70	2573.700	-67.370	-.040	-.000	1.000	1.00
1-1046	06:46:00	18.9222	121.70	2573.800	-67.270	.100	.035	1.000	1.00
1-1047	06:48:00	18.9556	121.70	2573.730	-67.340	-.070	.049	1.000	1.00
1-1048	06:50:00	18.9889	121.70	2573.690	-67.380	-.040	.030	1.000	1.00
1-1049	06:52:00	19.0222	121.70	2573.680	-67.390	-.010	.022	1.000	1.00
1-1050	06:54:00	19.0556	121.70	2573.710	-67.360	.030	.026	1.000	1.00
1-1051	06:56:00	19.0889	121.70	2573.670	-67.400	-.040	.015	1.000	1.00
1-1052	06:58:00	19.1222	121.70	2573.690	-67.380	.020	-.012	1.000	1.00
1-1053	07:00:00	19.1556	121.70	2573.740	-67.330	.050	-.019	1.000	1.00
1-1054	07:02:00	19.1889	121.70	2573.740	-67.330	0.000	-.012	1.000	1.00
1-1055	07:04:00	19.2222	121.70	2573.740	-67.330	0.000	-.025	1.000	1.00
1-1056	07:06:00	19.2556	121.70	2573.740	-67.330	0.000	-.012	1.000	1.00
1-1057	07:08:00	19.2889	121.70	2573.780	-67.290	.040	.009	1.000	1.00
1-1058	07:10:00	19.3222	121.70	2573.730	-67.340	-.050	-.005	1.000	1.00
1-1059	07:12:00	19.3556	121.70	2573.770	-67.300	.040	.014	1.000	1.00
1-1060	07:14:00	19.3889	121.70	2573.710	-67.360	-.060	.019	1.000	1.00
1-1061	07:16:00	19.4222	121.70	2573.690	-67.380	-.020	-.013	1.000	1.00
1-1062	07:18:00	19.4556	121.70	2573.690	-67.380	0.000	.002	1.000	1.00
1-1063	07:20:00	19.4889	121.70	2573.760	-67.310	.070	.021	1.000	1.00
1-1064	07:22:00	19.5222	121.70	2573.660	-67.410	-.100	.009	1.000	1.00
1-1065	07:24:00	19.5556	121.70	2573.780	-67.290	.120	.020	1.000	1.00
1-1066	07:26:00	19.5889	121.70	2573.700	-67.370	-.080	.004	1.000	1.00
1-1067	07:28:00	19.6222	121.70	2573.660	-67.410	-.040	-.006	1.000	1.00
1-1068	07:30:00	19.6556	121.70	2573.720	-67.350	.060	-.017	1.000	1.00

K+E 10 X 10 TO THE INCH • 7 X 10 INCHES  
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 0700

FALL-OFF TEST

- 2,690

- 2,670

- 2,650

- 2,630

- 2,610

- 2,590

- 2,570

PRESSURE

At IN HOURS

12

10

8

6

4

2

1

0

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

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20

GULF COAST WELL ANALYSTS

HOECHST CELANESE  
FIELD : BAY CITY PLANT  
ZONE : 5600  
WELL #: WDW 110 # 1-A  
OCTOBER 30, 1989 -- T<sub>0</sub> = 14:50:40

K-E  
SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS  
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 6210

FALL-OFF TEST

HOECHST CELANESE  
FIELD : BAY CITY PLANT  
ZONE : 5600  
WELL #: WDN 110 # 4-A  
OCTOBER 30, 1989 --  $T_0 = 11:50:40$

GULF COAST WELL ANALYSIS

PRESSURE

2,690

2,670

2,650

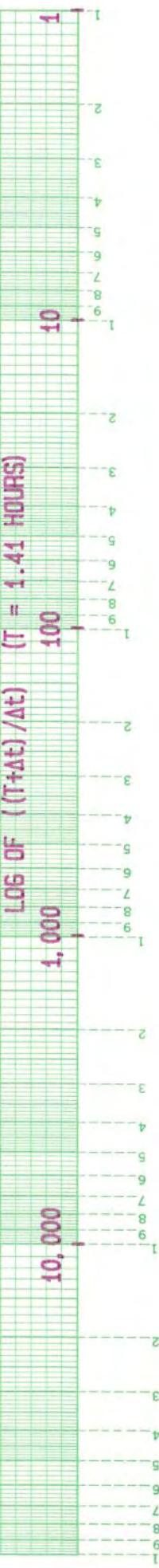
2,630

2,610

2,590

2,570





FALL-OFF TEST

4hr

-2,670

-2,650

-2,630

-2,610

-2,590

-2,570

PRESSURE

GULF COAST WELL ANALYSIS

HOECHST CELANESE

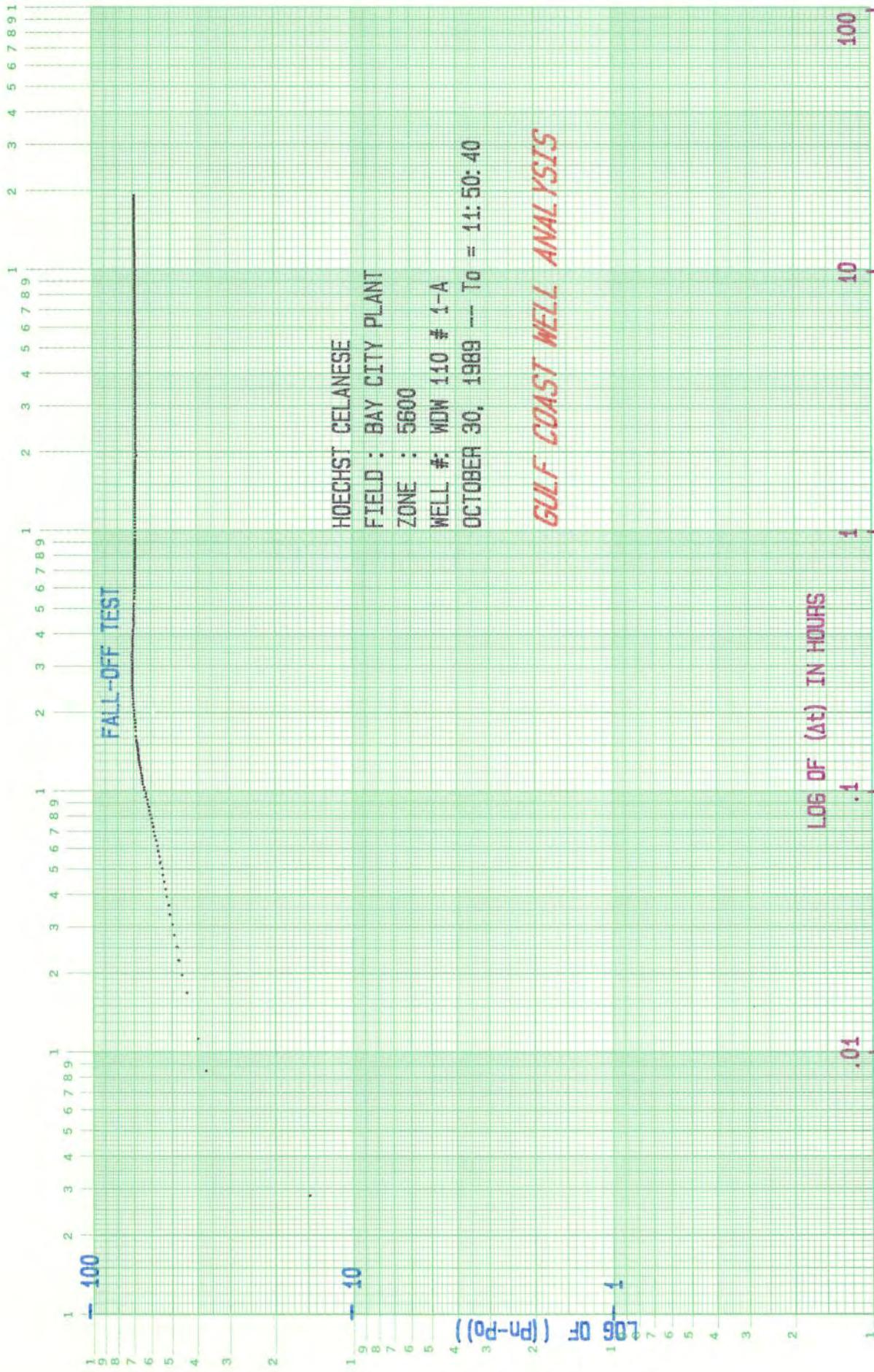
FIELD : BAY CITY PLANT

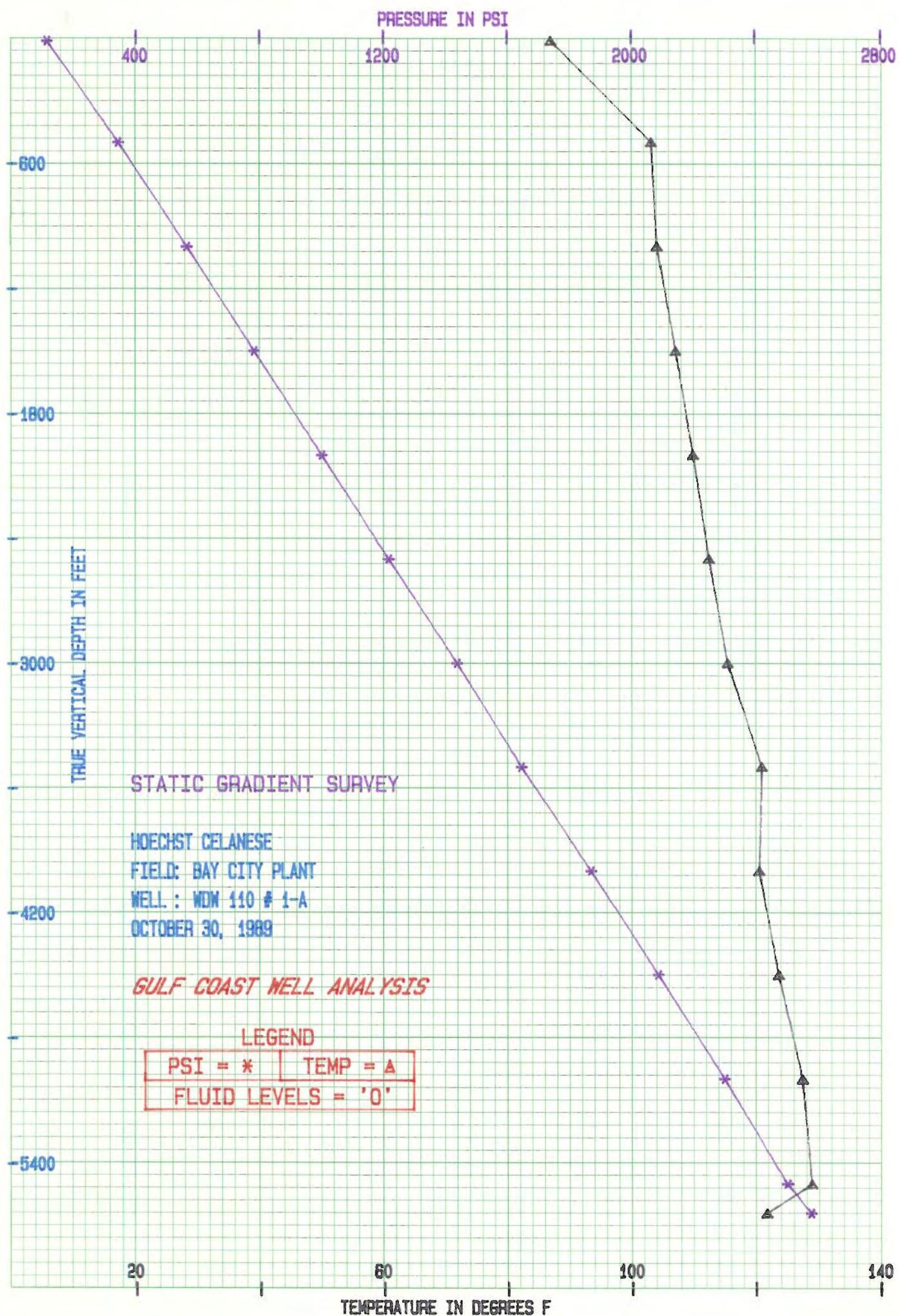
ZONE : 5600

OCTOBER 30, 1969 -- TO = 11:50:40  
MELL #: MWD 110 # 1-A

**KΣ** LOGARITHMIC 3 X 5 CYCLES  
KEUFFEL & ESSER CO., MADE IN U.S.A.

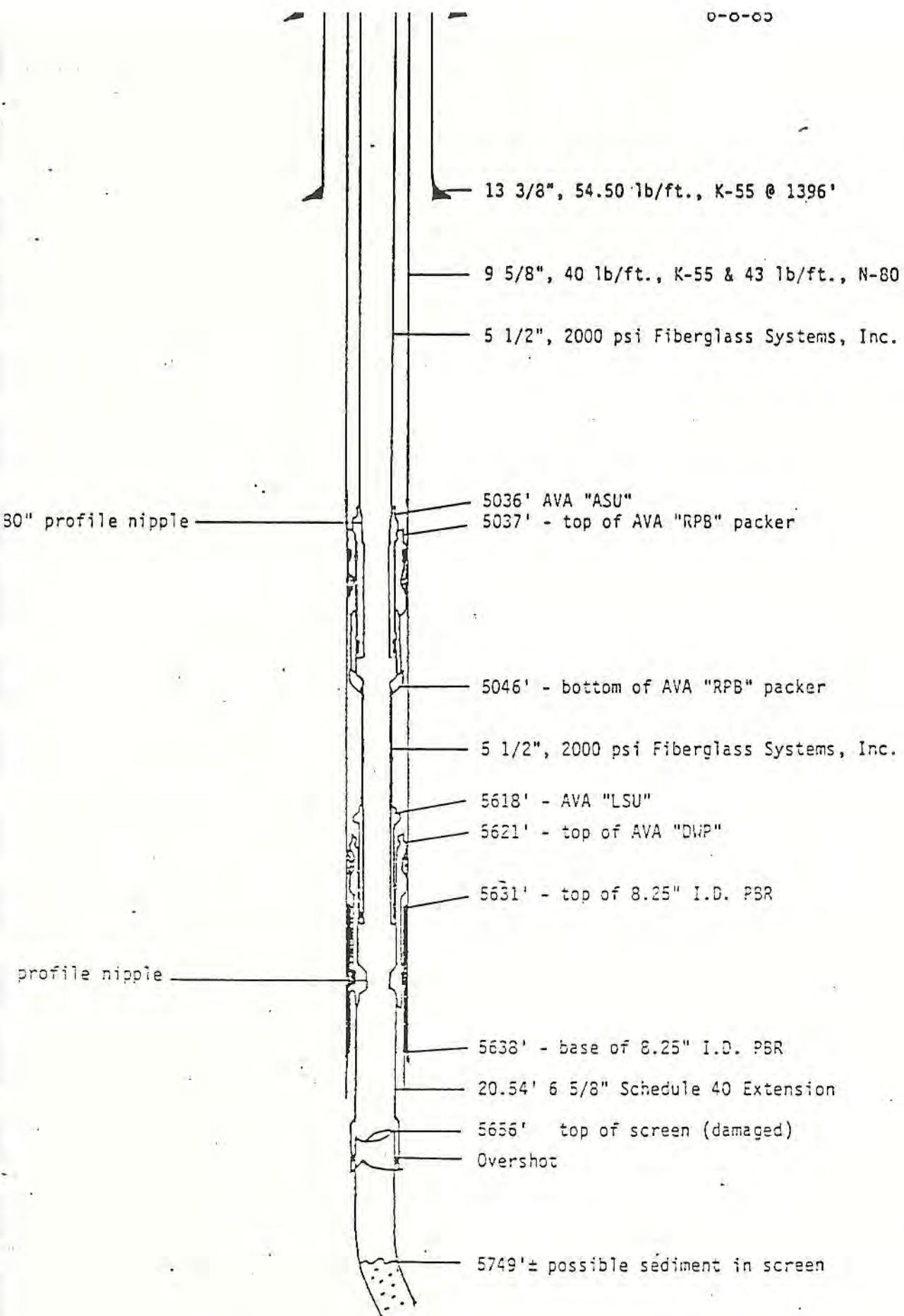
46 7520





APPENDIX D.3  
WELL SCHEMATIC DRAWING





Measurements are from K.B.

CDW #110

APPENDIX E  
CORRESPONDENCE



Date October 3, 1989 IOC-251-89  
To: H. R. Horton From: I. O. Coleman, Jr.  
Dept/Location: Bay City Plant Dept/Location: Bay City Plant  
Subject: Texas Water Commission (TWC) Approval of Proposed  
Mechanical Integrity Testing of Bay City Plant Injection Wells  
(Reference Letter, IOC-238-89, Dated September 18, 1989)

cc: C. R. Pennington - w/o Attach. E. H. Chiu  
B. L. Fritz - w/o Attach R. D. Riley  
G. E. Organ ---> Environmental File 203.13  
H. P. Heathman - w/o Attach M. J. Valenta  
W. G. Cornman - " " R. C. Hayes  
R. S. O'Neal - " " M. L. Harvel  
J. R. Rod - " " R. H. Maurer - Dallas  
B. J. Chodkiewicz " " G. M. Rowen - Bridgewater  
G. J. McCarthy W. W. Smith - Golden  
B. A. Logue StrataService, Inc.

The attached letter, dated September 27, 1989, from TWC documents approval of the proposed procedures (submitted to TWC under the above reference letter) for conducting mechanical integrity testing (MIT) on our injection wells with the following requirements:

- o Annulus Pressure Test (APT); the APT shall consist of maintaining a positive annulus pressure differential over tubing pressure during the specified time frame for each well. (Reference step number 4, of Attachments 1 and 3 and step number 5 of Attachments 2 and 4 of the proposed procedures).
- o Stationary Survey; TWC indicates that a stationary survey will be required with the detector located approximately 20 feet above the perforated interval in addition to the stationary survey 20 feet above the packer. (Reference step number 5, of Attachments 1 and 3 and step number 6 of Attachments 2 and 4 of the proposed procedures).

Also, we are required to submit a report to TWC within 30 days of completion of the MIT. Please refer to TWC's letter to ascertain the minimum requirements as to the contents of the report.

Per your request, Mr. Wesley W. Smith, Golden StrataServices, Inc., is on the distribution list of this letter.

Please contact me if you have any problems, comments and/or questions about the additional requirements TWC has requested for inclusion in the MIT procedures.

  
I. O. Coleman, Jr.

## Interoffice Memo

Hoechst Celanese

Date: July 21, 1989

To: I. O. Coleman

From: H. R. Horton

Dept/Location: Lab

Dept/Location: Maintenance Engineering  
HRH-163-M-89Subject: Mechanical Integrity Testing (MIT),  
WDW-14, 32, 49, and 110cc: R. E. Allen  
R. S. O'Neal  
W. G. Cornman  
H. P. Heathman  
G. J. McCarthy  
B. A. LogueE. H. Chiu  
R. C. Hayes  
M. L. Harvel  
G. E. Organ  
B. L. Fritz - J. R. Rod

Please request and secure approval from the Texas Water Commission to demonstrate mechanical integrity on our waste injection wells WDW Nos. 14, 32, 49, and 110.

Annulus pressure test (APT) will be conducted on WDW-14 at 800 psig for 60 minutes; WDW-32 at 1000 psig for 30 minutes; WDW-49 at 1000 psig for 30 minutes; and WDW-110 at 650 psig for 60 minutes.

A pressure falloff/bottomhole pressure test (BHP) will be conducted on two wells, WDW-32 and WDW-110. There will be no BHP performed on WDW-14 and WDW-49 because they are in the same upper Miocene injection sand as WDW-32. All three wells are in pressure communication and one pressure test will be representative of all three.

The mechanical integrity test for WDW Nos. 14, 32, and 49 are tentatively scheduled for October 23 - 26, 1989 and for WDW-110 on October 30 and 31, 1989.

  
H. R. Horton

HRH/lrk

File: 6.5.0.0-M

**Hoechst Celanese**

**Chemical Group**  
Bay City Plant  
Hoechst Celanese Corporation  
PO Box 509, FM 3057  
Bay City, TX 77404-0509  
409 245 4871

September 18, 1989  
IOC-239-89

Mr. Tom Roth, Chief  
Underground Injection Control Section  
Texas Water Commission  
P. O. Box 13087, Capitol Station  
1700 North Congress Avenue  
Austin, Texas 78711-3087

**Subject:** Mechanical Integrity Testing Proposal for Hoechst Celanese  
Chemical Group, Inc., Bay City Plant Underground Injection  
Wells for Calendar Year 1989  
(Re: WDW-14, 32, 49 and 110)

Dear Mr. Roth:

Proposed procedures, which were generated by our Contractor (Golden StrataServices, Inc.), for demonstrating mechanical integrity testing (MIT) of WDW-14, 32, 49 and 110 are enclosed as ATTACHMENT NOS. 1-4 respectively and are provided for your information and approval. In addition to the MIT, we will perform pressure fall-off and static bottom hole pressure (BHP) tests only on WDW-32 and 110. We do not plan to perform BHP tests on WDW-14 and 49 since they are in the same upper Miocene injection sands as WDW-32. However, we will perform annulus pressure (APT) tests and radioactive tracer surveys on each of the injection wells.

Per Attachment Nos. 1 and 4, we request permission to perform the APT on WDW-14 at 800 psig for 60 minutes and on WDW-110 at 650 psig for 60 minutes. The APT on WDW-32 and WDW-49 will be performed at +/- 1000 psig per Attachment Nos. 2 and 3 for 30 minutes respectively.

The MIT for WDW-14, 32 and 49 is tentatively scheduled for October 23-26, 1989 and October 30-31, 1989 for WDW-110 per the proposed schedule enclosed as Attachment No. 5.

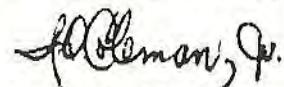
Your timely consideration of our requests for: (1) approval of the proposed procedures for demonstrating MIT's on our injection wells and (2) permission to perform lowered annulus pressure tests on WDW-14 and WDW-110 is appreciated.

IOC-239-89

Page 2

Please contact me by telephone at 409/245-4871, Ext. 4197 or Mr. H. R. Horton at Ext. 4076 if you have any comments or questions about this matter.

Yours very truly,



I. O. Coleman, Jr.

IOC/las

Attach.

cc: Mr. Richard Merritt  
Underground Injection Control Section  
Texas Water Commission  
P. O. Box 13087, Capitol Station  
1700 North Congress Avenue  
Austin, Texas 78711-3087

Mr. Russell S. Kimble, Chief  
Hazardous and Solid Waste Enforcement Section  
Hazardous Solid Waste Division  
Texas Water Commission  
P. O. Box 13087, Capitol Station  
1700 North Congress Avenue  
Austin, Texas 78711-3087

ATTACHMENT NO. 1

PROPOSED PROCEDURES TO DEMONSTRATE  
MECHANICAL INTEGRITY TESTING  
HOECHST CELANESE - CHEMICAL GROUP  
WDW-14  
BAY CITY FACILITY

The following step-by-step proposed mechanical integrity testing (MIT) procedures were developed in accordance with the Underground Injection Control (UIC) and the Hazardous Waste Disposal Injection Restrictions (HWDIR) Programs issued by the United States Environmental Protection Agency (US EPA) and promulgated by the Texas Water Commission (TWC). Except where noted, all steps of this procedure will be performed by Golden StrataServices' (GSS) personnel.

- 1). Request and secure approval from the TWC to demonstrate MIT (HCCG & GSS).
  - \* Define annulus pressure test, type logging tools and downhole logging procedures and submit to HCCG (GSS).
  - \* GSS will draft the MIT procedures which will provide formal notification of the intent to demonstrate MIT.
  - \* HCCG will issue the procedures to the TWC for review and acceptance.
  - \* Receive approval letter from TWC on proposed MIT.
- 2). Notify the TWC field inspector of the scheduled MIT (HCCG).
  - \* Notify the field inspector by letter of the date field work is scheduled and the estimated starting time for the first test to be witnessed by the TWC.
  - \* Determine the intent of TWC to field witness MIT.
  - \* Determine desire of TWC for any special documentation of test results.
- 3). Prepare well for MIT (HCCG).
  - \* Test master valve to make sure that it will open, close and seal off properly.
  - \* Check wellhead valves to insure that standard fittings can be installed during the MIT. GSS requests that a 2" NPT connections, or standard oil field size adapter, be available on the tubing and casing outlets.
  - \* HCCG's personnel will maintain proper annulus pressure while conducting the RAT survey.
  - \* Just prior to and during the MIT, HCCG will use non-hazardous process fluid to inject into WDW 14..



4). Perform annulus pressure test (APT).

- \* Install calibrated pressure gauge onto the annulus. Also, HCCG will furnish and install a pressure recorder.
- \* HCCG's personnel will slowly pressurize the annulus using nitrogen gas to +/-800 psig. The annulus is reportedly filled with inhibited brine.
- \* Monitor casing pressure for a minimum period of 60 minutes. Maximum allowable pressure leak-off rate during test is 5% per 30 minutes of maximum test pressure.
- \* Gradually bleed off annulus pressure to normal operating level.

5). Run RAT survey.

- \* Rig up electrical wireline service unit including a gamma ray (G/R) detector, casing collar locator (CCL) and RAT ejector tool. Ejector will contain +/-5 millicuries of Iodine 131 radioactive (R/A) solution. Install lubricator on top of wellhead. Run RAT tool to plugged back total depth (PBTD). Tag & record bottommost depth of wellbore.
- \* Run initial base G/R log from just below perforated section up to +/-300' above the packer (@3162'), or up to +/-2800'. Make repeat G/R run in cased section to prove G/R tool repeatability.
- \* Run one (1) five-minute statistical log at a depth of 3150'.  
*at 3430*
- \* Commence pumping effluent fluid down tubing using HCCG's injection pumps at a steady rate.
- \* Release first R/A slug inside tubing at +/-2800' while pumping fluid down the tubing at the rate of +/-40 gpm. Note: This same injection rate will be used on all wells during the RAT surveys. Make multiple recorded passes following the R/A slug (1) down the tubing, (2) into the borehole and (3) into the disposal zone until the R/A slug virtually disappears and cannot be distinguished from the normal background G/R radioactivity.  
*Release second R/A slug from tool at +/-2800' and run tool to +/-3150'. Hold tool stationary. Place recorder on time-drive sequence. Logging time will be predetermined based on actual injection rate and as agreed upon with the TWC inspector. Repeat stationary test ~~with tool at 3430~~*
- \* Run final base G/R from just below base of perforated section up to +/-2800' (same interval as original base G/R log) to verify that all R/A materials have been flushed into the disposal zone and that no fluid is



migrating up behind the casing strings. Pull tool out of the hole.

6). MIT field work is completed.

- \* Rig down all rental equipment and move either to the next injection well or off the location.
- \* Advise TWC of test results and that injection well is, or is not, ready to resume injection service. If MIT fails, submit a workover procedure to the TWC. Note: The latter work is not included in the scope of this project.

7). Submit MIT report (HCCG & GSS).

- \* Prepare a draft MIT report detailing the demonstration of MIT on WDW No. 14 (GSS).
- \* Submit draft report to HCCG for comments and approval (GSS).
- \* HCCG will review the MIT report and return same to GSS. GSS will issue seven (7) copies of the final report to HCCG. HCCG will transmit a copy to the TWC.
- \* Receive TWC's acceptance of the MIT report.

8). Mechanical Integrity Testing Complete.



ATTACHMENT NO. 2

PROPOSED PROCEDURES TO DEMONSTRATE  
MECHANICAL INTEGRITY TESTING  
HOECHST CELANESE - CHEMICAL GROUP  
WDW-32  
BAY CITY FACILITY

The following step-by-step proposed mechanical integrity testing (MIT) procedures were developed in accordance with the Underground Injection Control (UIC) and the Hazardous Waste Disposal Injection Restrictions (HWDIR) Programs issued by the United States Environmental Protection Agency (US EPA) and promulgated by the Texas Water Commission (TWC). Except where noted, all steps of this procedure will be performed by Golden StrataServices' (GSS) personnel.

- 1). Request and secure approval from the TWC to demonstrate MIT (HCCG & GSS).
  - \* Define annulus pressure test, type logging tools and downhole logging procedures and submit to HCCG (GSS).
  - \* GSS will draft the MIT procedures which will provide formal notification of the intent to demonstrate MIT. Procedures will be send to HCCG.
  - \* HCCG will issue the procedures to the TWC for review and acceptance.
  - \* Receive approval letter from TWC on proposed MIT.
- 2). Notify the TWC field inspector of the scheduled MIT (HCCG).
  - \* Notify the field inspector by letter of the date field work is scheduled and the estimated starting time for the first test to be witnessed by the TWC.
  - \* Determine the intent of TWC to field witness MIT.
  - \* Determine desire of TWC for any special documentation of test results.
- 3). Prepare well for MIT (HCCG).
  - \* Test master valve to make sure that it will open, close and seal off properly.
  - \* Since a BHP bomb will be run while injecting process fluid into the well, a full-opening valve (minimum 2" inside diameter) should be installed on top of the wellhead above the inlet effluent flowline prior to starting MIT.
  - \* Check wellhead valves to insure that standard fittings can be installed during the MIT. GSS requests that a



- \* 2" NPT connections, or standard oil field size adapter, be available on the tubing and casing outlets.
- \* HCCG's personnel will maintain proper annulus pressure while conducting the RAT survey.
- \* Just prior to and during the MIT, HCCG will use non-hazardous process fluid to inject into WDW 32.

4). Perform pressure fall-off and static BHP survey.

- \* While injecting process fluid into well using HCCG's injection pumps rig up and run a digital pressure bomb run on wireline to a depth of +/-3300'. Continue injecting fluid into well for +/-1 hour.
- \* Shut-in well. Leave well shut-in for +/-24 hours to obtain pressure decay data. Data obtained at the end of this test will provide static BHP.
- \* Pull bomb out of the hole making gradient stops every 500' starting at 3000' to the surface. Record surface shut-in tubing pressure. Examine BHP data to determine if shut-in time is adequate for definitive BHP data.

5). Perform annulus pressure test (APT).

- \* Install calibrated pressure gauge onto the annulus. HCCG will furnish and install a pressure recorder.
- \* HCCG's personnel will slowly pressurize the annulus using nitrogen gas to +/-1,000 psig. The annulus is reportedly filled with inhibited brine.
- \* Monitor casing pressure for a minimum period of 30 minutes. Maximum allowable pressure leak-off rate during test is 5% per 30 minutes of maximum test pressure.
- \* Gradually bleed off annulus pressure to normal operating level.

6). Run RAT survey

- \* Rig up electrical wireline service unit including a gamma ray (G/R) detector, casing collar locator (CCL) and radioactive tracer (RAT) ejector tool. Ejector will contain +/-5 millicuries of Iodine "131" radioactive (R/A) solution. Install lubricator on top of wellhead. Run RAT tool to plugged back total depth (PBTD). Tag & record bottommost depth of wellbore.
- \* Run initial base G/R log from base of screen liner section up to +/-300' above the packer (@3245'), or to +/-2900' Make repeat G/R run in cased section to prove G/R tool repeatability.
- \* Run one (1) five-minute statistical log at a depth of 3225'.



- \* Commence pumping effluent fluid down tubing using HCCG's injection pumps at a steady rate.
- \* Release first R/A slug inside tubing at +/-2900' while pumping fluid down the tubing at the rate of +/-40 gpm. Make multiple recorded passes following the R/A slug (1) down the tubing, (2) into the borehole and (3) into the disposal zone until the R/A slug virtually disappears and cannot be distinguished from the normal background G/R radioactivity.
- \* *3150* Release second R/A slug from tool at +/-2900' and run tool to +/-3225'. Hold tool stationary. Place recorder on time-drive sequence. Logging time will be predetermined based on actual injection rate and as agreed upon with the TWC inspector. Repeat stationary test *with tool at*
- \* Run final base G/R from just below base of screened section up to +/-2900' (same interval as original base G/R log) to verify that all R/A materials have been flushed into the disposal zone and that no fluid is migrating up behind the casing strings. Pull tool out of the hole.

7). MIT field work is completed.

- \* Rig down all rental equipment and either move to the next injection well or off the location.
- \* Advise TWC of test results and that injection well is, or is not, ready to resume injection service. If MIT fails submit a workover procedure to the TWC. Note: The latter work is not included in the scope of this project.

8). Submit MIT report (HCCG & GSS).

- \* Prepare a draft MIT report detailing the demonstration of MIT on WDW No. 32 (GSS).
- \* Submit draft report to HCCG for comments and approval.
- \* HCCG will review the MIT report and return same to GSSpp. GSS will issue seven (7) copies of the final report. HCCG will issue a copy of the final report to the TWC.
- \* Receive TWC's acceptance of the MIT report.

9). Mechanical Integrity Testing Complete.



ATTACHMENT NO. 3

PROPOSED PROCEDURES TO DEMONSTRATE  
MECHANICAL INTEGRITY TESTING  
HOECHST CELANESE - CHEMICAL GROUP  
WDW-49  
BAY CITY FACILITY

The following step-by-step proposed mechanical integrity testing (MIT) procedures were developed in accordance with the Underground Injection Control (UIC) and the Hazardous Waste Disposal Injection Restrictions (HWDIR) Programs issued by the United States Environmental Protection Agency (US EPA) and promulgated by the Texas Water Commission (TWC). Except where noted, all steps of this procedure will be performed by Golden StrataServices' (GSS) personnel.

- 1). Request and secure approval from the TWC to demonstrate MIT (HCCG & GSS).
  - \* Define annulus pressure test, type logging tools and downhole logging procedures and submit to HCCG (GSS).
  - \* GSS will draft the MIT procedures which will provide formal notification to the TWC of the intent to demonstrate MIT. Procedures will be send to HCCG.
  - \* HCCG will transmit the procedures to the TWC for review and acceptance.
  - \* Receive approval letter from TWC on proposed MIT.
- 2). Notify the TWC field inspector of the scheduled MIT (HCCG).
  - \* Notify the field inspector by letter of the date field work is scheduled and the estimated starting time for the first test to be witnessed by the TWC.
  - \* Determine the intent of TWC to field witness MIT.
  - \* Determine desire of TWC for any special documentation of test results.
- 3). Prepare well for MIT (HCCG).
  - \* Test master valve to make sure that it will open, close and seal off properly.
  - \* Check wellhead valves to insure that standard fittings can be installed during the MIT. GSS requests that a 2" NPT connections, or standard oil field size adapter, be available on the tubing and casing outlets.
  - \* HCCG's personnel will maintain proper annulus pressure while conducting the RAT survey.
  - \* Just prior to and during the MIT, HCCG will use non hazardous process fluid to inject into WDW 49.



4). Perform annulus pressure test.

- \* Install calibrated pressure gauge onto the annulus. Also, HCCG will furnish and install a pressure recorder.
- \* HCCG's personnel will slowly pressurize the annulus using nitrogen gas to +/-1,000 psig. The annulus is reportedly filled with inhibited brine.
- \* Monitor casing pressure for a minimum period of 30 minutes. Maximum allowable pressure leak-off rate during test is 5% per 30 minutes of maximum test pressure.
- \* Gradually bleed off annulus pressure to normal operating level.

5). Run RAT survey.

- \* Rig up electrical wireline service unit including a gamma ray (G/R) detector, casing collar locator (CCL) and radioactive tracer (RAT) ejector tool. Ejector will contain +/-5 millicuries of Iodine 131 radioactive (R/A) solution. Install lubricator on top of wellhead. Run RAT tool to plugged back total depth (PBTD). Tag & record bottommost depth of the wellbore.
- \* Run initial base G/R log from just below perforated (or screen liner) section up to +/-300' above the packer (@3316'), or up to +/-3000'. Make repeat G/R run in cased section to prove G/R tool repeatability.
- \* Run one (1) five-minute statistical log at a depth of +/-3300' ~~3295~~ <sup>E&L</sup> 3350
- \* Commence pumping effluent fluid down tubing using HCCG's injection pumps at a steady rate.
- \* Release first R/A slug inside tubing at +/-3000' while pumping fluid down the tubing at the rate of +/-40 gpm. Make multiple recorded passes following the R/A slug (1) down the tubing, (2) into the borehole and (3) into the disposal zone until the R/A slug virtually disappears and cannot be distinguished from the normal background G/R radioactivity.
- \* Release second R/A slug from tool at +/-3000' and run tool to +/-3300' ~~3295~~ Hold tool stationary. Place recorder on time-drive sequence. Logging time will be predetermined based on actual injection rate and as agreed upon with the TWC inspector. Repeat stationary test ~~tool hold at 3350~~
- \* Run final base G/R from just below base of screened section up to +/-3000' (same interval as original base G/R log) to verify that all R/A materials have been flushed into the disposal zone and that no fluid is migrating up behind the casing strings. Pull tool out of the hole.



6). MIT field work is completed.

- \* Rig down all rental equipment and either move to the next injection well or off the location.
- \* Advise TWC of test results and that injection well is, or is not, ready to resume injection service. If MIT fails submit a workover procedure to the TWC. Note: The latter work is not included in the scope of this project.

7). Submit MIT report (HCCG & GSS).

- \* Prepare a draft MIT report detailing the demonstration of MIT on WDW No. 49 (GSS).
- \* Submit draft report to HCCG for comments and approval (GSS).
- \* HCCG will review the MIT report and return same to GSS. GSS will transmit seven (7) copies of the final report to HCCG. HCCG will issue a copy of the final report to the TWC.
- \* Receive TWC's acceptance of the MIT report.

8). Mechanical Integrity Testing Complete.



ATTACHMENT NO. 4

PROPOSED PROCEDURES TO DEMONSTRATE  
MECHANICAL INTEGRITY TESTING  
HOECHST CELANESE - CHEMICAL GROUP  
WDW-110  
BAY CITY FACILITY

The following step-by-step proposed mechanical integrity testing (MIT) procedures were developed in accordance with the Underground Injection Control (UIC) and the Hazardous Waste Disposal Injection Restrictions (HWDIR) Programs issued by the United States Environmental Protection Agency (US EPA) and promulgated by the Texas Water Commission (TWC). Except where noted, all steps of this procedure will be performed by Golden StrataServices' (GSS) personnel.

- 1). Request and secure approval from the TWC to demonstrate MIT (HCCG & GSS).
  - \* Define annulus pressure test, type logging tools and downhole logging procedures and submit to HCCG (GSS).
  - \* GSS will draft MIT procedures which will provide formal notification to the TWC of the intent to demonstrate MIT. Send procedures to HCCG.
  - \* HCCG will transmit the procedures to the TWC for review and acceptance.
  - \* Receive approval letter from TWC on proposed MIT.
- 2). Notify the TWC field inspector of the scheduled MIT (HCCG).
  - \* Notify the field inspector by letter of the date field work is scheduled and the estimated starting time for the first test to be witnessed by the TWC.
  - \* Determine the intent of TWC to field witness MIT.
  - \* Determine desire of TWC for any special documentation of test results.
- 3). Prepare well for MIT (HCCG).
  - \* Test master valve to make sure that it will open, close and seal off properly.
  - \* Since a BHP bomb will be run while injecting brine into the well, a full-opening valve (minimum 2" inside diameter) should be installed on top of the wellhead above the inlet effluent flowline prior to starting MIT.



- \* Check wellhead valves to insure that standard fittings can be installed during the MIT. GSS requests that a 2" NPT connections, or standard oil field size adapter, be available on the tubing and casing outlets.
- \* A 2" NPT outlet or other threaded connection must be made available in the injection line, close to the wellhead, to allow the use of a pump truck.
- \* HCCG personnel will maintain proper annulus pressure while conducting the RAT survey.

4). Perform pressure fall-off and static BHP survey.

- \* Move in and rig up pump truck and peripheral equipment to pump brine into well.
- \* Slowly decrease the injection of process fluid into well and begin pumping brine with the pump truck. Continue to reduce process fluid rates (and eventually stop) while increasing the injection of brine. Match the brine injection rate to previous injection rates. Displace wellbore fluid with a minimum of 10,000 gallons of brine.
- \* Run a digital pressure bomb run on wireline to +/- 5,646', or 10' above the top of the screen. Note: Top of screen is damaged and cannot be accessed by wireline. Continue injecting fluid into the well for +/-1 hour.
- \* Shut-in well. Leave well shut-in for +/-24 hours to obtain pressure decay data. Data obtained at the end of this test will provide static BHP.
- \* Pull bomb out of the hole making gradient stops every 500' starting at 5300' to the surface. Record surface shut-in tubing pressure. Examine BHP data to determine if shut-in time is adequate for definitive BHP data.

5). Perform annulus pressure test (APT).

- \* Install calibrated pressure gauge onto the annulus. HCCG will furnish and install a pressure recorder.
- \* HCCG's personnel will slowly pressurize the annulus using nitrogen gas to +/-650 psig. The annulus is reportedly filled with inhibited brine. A-pump-truck will be available to perform this test.
- \* Monitor casing pressure for a minimum period of 60 minutes. Maximum allowable pressure leak-off rate during test is 5% per 30 minutes of maximum test pressure.
- \* Gradually bleed off annulus pressure to normal operating level.



6). Run RAT survey.

- \* Rig up electrical wireline service unit including a gamma ray (G/R) detector, casing collar locator (CCL) and radioactive tracer (RAT) ejector tool. Ejector contains +/-5 millicuries of Iodine 131 radioactive (R/A) solution. Install lubricator on top of wellhead. Run RAT tool to the top of the screen.
- \* Run initial base G/R log from top of screen liner section up to +/-300' above the top packer (@ 5,037'), or to +/-4,737'. Make repeat G/R run in cased section to prove G/R tool repeatability.
- \* Run one (1) five-minute statistical log at a depth of ~~+/-4,987'~~ S01S ~~at~~ S635
- \* Utilizing a pump truck, commence pumping brine fluid down the tubing at a steady rate.
- \* Release first R/A slug inside tubing at +/-4,737' while pumping fluid down the tubing at the rate of +/-40 gpm. Make multiple recorded passes following the R/A slug down the tubing to the top of the screen at 5,656'.
- \* Release second R/A slug from tool at +/-4,737' and run tool to ~~+/-4987'~~ S01S Hold tool stationary. Place recorder on time-drive sequence. Logging time will be predetermined based on actual injection rate and as agreed upon with the TWC inspector. Repeat stationary test ~~unit~~ ~~Tool~~ at S635
- \* Run final base G/R from just below base of screened section up to +/-4,737' (same interval as original base G/R log) to verify that all R/A materials have been flushed into the disposal zone and that no fluid is migrating up behind the casing strings.
- \* Pull tool out of the hole.

7). MIT field work is completed.

- \* Rig down all rental equipment and move off the location.
- \* Advise TWC of test results and that injection well is, or is not, ready to resume injection service. If MIT fails submit a workover procedure to the TWC.

8). Submit MIT report (HCCG & GSS).

- \* Prepare a draft MIT report detailing the demonstration of MIT on WDW No. 110 (GSS).
- \* Submit draft report to HCCG for comments and approval (GSS).
- \* HCCG will review the MIT report and return same to GSS. GSS will transmit seven (7) copies of the final MIT report to HCCG. HCCG will issue a copy of the final report to the TWC.
- \* Receive TWC's acceptance of the MIT report.



9). Mechanical Integrity Testing Complete.



# TEXAS WATER COMMISSION

B. J. Wynne, III, Chairman  
Paul Hopkins, Commissioner  
John O. Houchins, Commissioner



Allen Beinke, Executive Director  
Michael E. Field, General Counsel  
Brenda W. Foster, Chief Clerk

September 27, 1989

Mr. I. O. Coleman, Jr.  
Environmental Affairs Group Leader  
Hoechst Celanese Chemical Group, Inc.  
Bay City Plant  
P.O. Box 509  
Bay City, Texas 77404-0509

Re: Approval of Proposed Mechanical Integrity Testing, TWC  
Permit Nos. WDW-14, WDW-32, WDW-49 and WDW-110

Dear Mr. Coleman:

The staff has reviewed your request for mechanical integrity testing of the above referenced well and finds that it will meet the requirements outlined in 31 TAC § 331.64.d. with the following additions:

1. In reference to step number 4, of Attachments 1 and 3, and step number 5, of Attachments 2 and 4, of your proposal; the required pressure for the annulus pressure test (APT) shall consist of maintaining a positive annulus pressure differential over tubing pressure for the specified time frame.
2. In reference to step number 5, of Attachments 1 and 3, and step number 6, of Attachments 2 and 4, of your proposal; a stationary survey will be required with the detector located approximately 20 feet above the perforated interval in addition to the stationary survey 20 feet above the packer.

Pursuant to 31 TAC § 331.65.b.4., within 30 days of completion of the testing, please submit a report to the executive director containing, at a minimum, the following information:

1. A complete chronology and description of all tests performed and procedures followed;
2. An APT time/pressure table, and a copy of the recorder chart if one was made;
3. Copies of all logs run;
4. Interpretation and discussion of all testing and logging results, including the identity of personnel making the technical interpretations; and

Mr. I. O. Coleman  
Page 2

5. Certification by the individual preparing the reports that all test data is true and correct, and that the test procedures followed were submitted to, and received prior approval from the TWC UIC Unit.

If you have any questions, please contact Mr. Richard Merritt of my staff at 512/463-8532.

Sincerely,

*Paul S. Lewis* For  
Russell S. Kimble, Chief  
Hazardous and Solid Waste Enforcement Section  
Hazardous and Solid Waste Division

RM/rm

cc: Southeast Region - Deer Park Office  
Philip Dellinger, U.S.E.P.A. - Region VI (6WSU)

**APPENDIX D.3**

**WDW-110**  
**GULF COAST WELL ANALYSIS LOG INTERPRETATION LETTER**



GULF  
COAST  
WELL  
ANALYSIS

COASTAL WIRELINE SERVICES, INC.

HOECHST CELANESE CORPORATION  
CELANESE PLANT  
MATAGORDA COUNTY, TEXAS  
EFFLUENT DISPOSAL WELL #1A

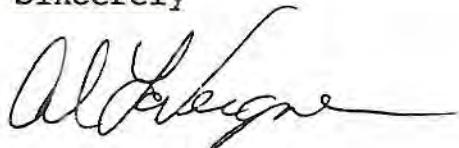
OCTOBER 31, 1990

To whom it may concern:

Radioactive Tracer Log was run to check for channeling.

Radioactive Tracer Log indicates that all fluid is going into disposal zone at this time. No indication of leaking or channeling behind pipe. This concludes Gulf Coast Well Analysis log interpretation for Effluent Disposal Well #1A.

Sincerely



Al LaVergne

**APPENDIX D.4**

**WDW-110**  
**STATIC AND FALL-OFF BOTTOM HOLE PRESSURE DATA**





## *Data Retrieval Corporation*

### INJECTION FALL-OFF TEST

---

HOECHST CELANESE

---

WELL NAME : WDW 110-1A  
SPIDR S/N : 1005  
ENGINEER : BOB HALL/GOLDEN STRATA RESOURCES  
LOCATION : BAY CITY, TEXAS  
DATE : 10/31-11/2, 1990  
SAMPLE WINDOW : 2 PSI  
SAMPLE RATE : 15 SECONDS

---

#### WELL DATA

---

TUBING LENGTH : 5,640 FT.  
TRUE VERT. DEPTH : 5,640 FT.

---

#### FLUIDS DATA

---

INJ. FLUID GRAVITY: 1.0

---

#### TEST SUMMARY

---

MIN WHP: 15 PSIA  
MIN BHP: 2,457 PSIA

---

MAX WHP: 412 PSIA  
MAX BHP: 1,906 PSIA

---

BHP'S WERE CALCULATED USING A 0.433 PSI/FT GRADIENT

DATA RETRIEVAL WELL TEST

Company : HOECHST CELANESE  
Well Name : WDW 110-1A  
Lease : BAY CITY WASTE DISPOSAL WELLS  
Location : BAY CITY, TEXAS  
SPIDR s.n.: 1005

Active Channels : 1

Start Time : Wednesday, 10/31/90 13:00:16  
End Time : Friday, 11/02/90 11:08:01  
Readings : 458  
Sample Window : 2 psi  
Sample Rate : 00:00:15 240 samples/hr.

CHANNEL 1

Label: WHP  
Min. : 14.3 Psia  
Max. : 229.4 Psia

Report Columns :

Column # Label

1	WHP	Min.:	16.00	Thursday, 11/01/90 07:31:16
		Max.:	229.00	Wednesday, 10/31/90 14:59:46
2	BHP	Min.:	2458.12	Thursday, 11/01/90 07:31:16
		Max.:	2671.12	Wednesday, 10/31/90 14:59:46
3	ELAPSED T	Min.:	13.00	Wednesday, 10/31/90 13:00:16
		Max.:	59.13	Friday, 11/02/90 11:08:01
4	DELTA T	Min.:	0.00	Wednesday, 10/31/90 13:00:16
		Max.:	46.13	Friday, 11/02/90 11:08:01

Location : BAY CITY, TEXAS  
Lease : BAY CITY WASTE DISPOSAL WELLS

Record	Date	Time	WHP	BHP	ELAPSED T	DELTA T
			Psia	PSIA	HOURS	HOURS
0001	10/31/90	13:00:16	183.00	2625.12	13.00	0.00
0002	Wednesday	13:00:46	186.00	2628.12	13.01	0.01
0003		13:01:31	182.00	2624.12	13.03	0.02
0004		13:01:46	180.00	2622.12	13.03	0.03
0005		13:02:01	183.00	2625.12	13.03	0.03
0006		13:03:46	185.00	2627.12	13.06	0.06
0007		13:04:16	182.00	2624.12	13.07	0.07
0008		13:05:16	184.00	2626.12	13.09	0.08
0009		13:06:01	186.00	2628.12	13.10	0.1
0010		13:06:31	182.00	2624.12	13.11	0.10
0011		13:07:01	185.00	2627.12	13.12	0.11
0012		13:07:31	182.00	2624.12	13.13	0.12
0013		13:08:16	184.00	2626.12	13.14	0.13
0014		13:12:01	183.00	2625.12	13.20	0.20
0015		13:13:01	185.00	2627.12	13.22	0.21
0016		13:14:01	183.00	2625.12	13.23	0.23
0017		13:14:31	185.00	2627.12	13.24	0.24
0018		13:15:01	183.00	2625.12	13.25	0.25
0019		13:17:16	185.00	2627.12	13.29	0.28
0020		13:18:01	182.00	2624.12	13.30	0.30
0021		13:19:31	184.00	2626.12	13.33	0.32
0022		13:20:31	182.00	2624.12	13.34	0.34
0023		13:20:46	185.00	2627.12	13.35	0.34
0024		13:21:31	182.00	2624.12	13.36	0.35
0025		13:24:31	180.00	2622.12	13.41	0.40
0026		13:24:46	182.00	2624.12	13.41	0.41
0027		13:27:31	184.00	2626.12	13.46	0.45
0028		13:27:46	181.00	2623.12	13.46	0.46
0029		13:30:31	178.00	2620.12	13.51	0.50
0030		13:31:16	180.00	2622.12	13.52	0.52
0031		13:35:01	182.00	2624.12	13.58	0.58
0032		13:35:46	180.00	2622.12	13.60	0.59
0033		13:37:01	182.00	2624.12	13.62	0.61
0034		13:37:31	186.00	2628.12	13.63	0.62
0035		13:37:46	184.00	2626.12	13.63	0.62
0036		13:38:01	182.00	2624.12	13.63	0.63
0037		13:40:16	184.00	2626.12	13.67	0.67
0038		13:41:31	186.00	2628.12	13.69	0.69
0039		13:42:31	188.00	2630.12	13.71	0.70
0040		13:43:46	190.00	2632.12	13.73	0.73
0041		13:45:01	192.00	2634.12	13.75	0.75
0042		13:46:01	194.00	2636.12	13.77	0.76
0043		13:47:31	191.00	2633.12	13.79	0.79
0044		13:47:46	195.00	2637.12	13.80	0.79
0045		13:49:01	197.00	2639.12	13.82	0.81
0046		13:49:16	199.00	2641.12	13.82	0.82
0047		13:49:46	197.00	2639.12	13.83	0.82
0048		13:50:16	199.00	2641.12	13.84	0.83
0049		13:51:31	201.00	2643.12	13.86	0.85
0050		13:54:01	203.00	2645.12	13.90	0.90

Location : BAY CITY, TEXAS  
Lease : BAY CITY WASTE DISPOSAL WELLS

Record	Date	Time	WHP	BHP	ELAPSED T	DELTA T
			Psia	PSIA	HOURS	HOURS
0051	10/31/90	13:56:16	205.00	2647.12	13.94	0.93
0052	Wednesday	13:56:31	203.00	2645.12	13.94	0.94
0053		13:57:16	205.00	2647.12	13.95	0.95
0054		13:58:16	207.00	2649.12	13.97	0.97
0055		13:58:31	205.00	2647.12	13.98	0.97
0056		13:59:31	207.00	2649.12	13.99	0.99
0057		13:59:46	205.00	2647.12	14.00	0.99
0058		14:02:31	207.00	2649.12	14.04	1.04
0059		14:03:16	209.00	2651.12	14.05	1.05
0060		14:03:31	206.00	2648.12	14.06	1.05
0061		14:05:16	208.00	2650.12	14.09	1.08
0062		14:05:46	205.00	2647.12	14.10	1.09
0063		14:07:01	208.00	2650.12	14.12	1.11
0064		14:09:16	210.00	2652.12	14.15	1.15
0065		14:09:46	208.00	2650.12	14.16	1.16
0066		14:10:46	210.00	2652.12	14.18	1.17
0067		14:11:01	207.00	2649.12	14.18	1.18
0068		14:11:16	212.00	2654.12	14.19	1.18
0069		14:11:46	205.00	2647.12	14.20	1.19
0070		14:12:01	208.00	2650.12	14.20	1.20
0071		14:12:31	204.00	2646.12	14.21	1.20
0072		14:13:01	209.00	2651.12	14.22	1.21
0073		14:13:16	204.00	2646.12	14.22	1.22
0074		14:13:46	209.00	2651.12	14.23	1.23
0075		14:14:01	207.00	2649.12	14.23	1.23
0076		14:14:31	209.00	2651.12	14.24	1.24
0077		14:14:46	212.00	2654.12	14.25	1.24
0078		14:15:31	210.00	2652.12	14.26	1.25
0079		14:15:46	212.00	2654.12	14.26	1.26
0080		14:16:16	210.00	2652.12	14.27	1.27
0081		14:16:31	212.00	2654.12	14.28	1.27
0082		14:16:46	214.00	2656.12	14.28	1.27
0083		14:17:01	212.00	2654.12	14.28	1.28
0084		14:17:46	214.00	2656.12	14.30	1.29
0085		14:18:31	212.00	2654.12	14.31	1.30
0086		14:19:16	215.00	2657.12	14.32	1.32
0087		14:19:46	213.00	2655.12	14.33	1.33
0088		14:20:46	215.00	2657.12	14.35	1.34
0089		14:21:46	211.00	2653.12	14.36	1.36
0090		14:22:01	213.00	2655.12	14.37	1.36
0091		14:22:16	216.00	2658.12	14.37	1.37
0092		14:22:31	214.00	2656.12	14.38	1.37
0093		14:22:46	210.00	2652.12	14.38	1.38
0094		14:23:16	212.00	2654.12	14.39	1.38
0095		14:23:31	216.00	2658.12	14.39	1.39
0096		14:24:16	209.00	2651.12	14.40	1.40
0097		14:24:31	216.00	2658.12	14.41	1.40
0098		14:24:46	211.00	2653.12	14.41	1.41
0099		14:25:31	214.00	2656.12	14.43	1.42
0100		14:26:16	212.00	2654.12	14.44	1.43

Location : BAY CITY, TEXAS

Lease : BAY CITY WASTE DISPOSAL WELLS

Record	Date	Time	WHP	BHP	ELAPSED T	DELTA T
			Psia	PSIA	HOURS	HOURS
0101	10/31/90	14:26:31	214.00	2656.12	14.44	1.44
0102	Wednesday	14:27:16	216.00	2658.12	14.45	1.45
0103		14:29:16	218.00	2660.12	14.49	1.48
0104		14:29:31	216.00	2658.12	14.49	1.49
0105		14:29:46	218.00	2660.12	14.50	1.49
0106		14:30:31	216.00	2658.12	14.51	1.50
0107		14:31:01	219.00	2661.12	14.52	1.51
0108		14:31:46	222.00	2664.12	14.53	1.52
0109		14:32:01	219.00	2661.12	14.53	1.53
0110		14:33:46	217.00	2659.12	14.56	1.56
0111		14:34:01	219.00	2661.12	14.57	1.56
0112		14:34:31	221.00	2663.12	14.58	1.57
0113		14:34:46	219.00	2661.12	14.58	1.58
0114		14:37:01	217.00	2659.12	14.62	1.61
0115		14:37:16	219.00	2661.12	14.62	1.62
0116		14:39:01	216.00	2658.12	14.65	1.65
0117		14:39:31	214.00	2656.12	14.66	1.65
0118		14:39:46	216.00	2658.12	14.66	1.66
0119		14:41:01	218.00	2660.12	14.68	1.68
0120		14:42:01	216.00	2658.12	14.70	1.70
0121		14:42:16	219.00	2661.12	14.70	1.70
0122		14:42:31	217.00	2659.12	14.71	1.70
0123		14:43:46	220.00	2662.12	14.73	1.73
0124		14:44:31	218.00	2660.12	14.74	1.74
0125		14:45:16	220.00	2662.12	14.75	1.75
0126		14:45:31	218.00	2660.12	14.76	1.75
0127		14:47:01	209.00	2651.12	14.78	1.78
0128		14:47:16	202.00	2644.12	14.79	1.78
0129		14:47:31	197.00	2639.12	14.79	1.79
0130		14:47:46	193.00	2635.12	14.80	1.79
0131		14:48:01	189.00	2631.12	14.80	1.80
0132		14:48:16	187.00	2629.12	14.80	1.80
0133		14:48:46	184.00	2626.12	14.81	1.81
0134		14:49:31	179.00	2621.12	14.83	1.82
0135		14:49:46	164.00	2606.12	14.83	1.83
0136		14:50:01	157.00	2599.12	14.83	1.83
0137		14:50:16	154.00	2596.12	14.84	1.83
0138		14:50:31	152.00	2594.12	14.84	1.84
0139		14:50:46	150.00	2592.12	14.85	1.84
0140		14:51:01	187.00	2629.12	14.85	1.85
0141		14:51:16	183.00	2625.12	14.85	1.85
0142		14:51:31	181.00	2623.12	14.86	1.85
0143		14:51:46	179.00	2621.12	14.86	1.86
0144		14:52:01	174.00	2616.12	14.87	1.86
0145		14:52:16	75.00	2517.12	14.87	1.87
0146		14:52:31	34.00	2476.12	14.88	1.87
0147		14:52:46	29.00	2471.12	14.88	1.88
0148		14:53:01	27.00	2469.12	14.88	1.88
0149		14:53:16	25.00	2467.12	14.89	1.88
0150		14:54:31	28.00	2470.12	14.91	1.90

Location : BAY CITY, TEXAS  
Lease : BAY CITY WASTE DISPOSAL WELLS

Record	Date	Time	WHP	BHP	ELAPSED T	DELTA T
			Psia	PSIA	HOURS	HOURS
0151	10/31/90	14:54:46	30.00	2472.12	14.91	1.91
0152	Wednesday	14:55:01	33.00	2475.12	14.92	1.91
0153		14:55:16	37.00	2479.12	14.92	1.92
0154		14:55:31	41.00	2483.12	14.93	1.92
0155		14:55:46	45.00	2487.12	14.93	1.92
0156		14:56:01	51.00	2493.12	14.93	1.93
0157		14:56:16	214.00	2656.12	14.94	1.93
0158		14:56:31	200.00	2642.12	14.94	1.94
0159		14:56:46	187.00	2629.12	14.95	1.94
0160		14:57:01	183.00	2625.12	14.95	1.95
0161		14:57:16	196.00	2638.12	14.95	1.95
0162		14:57:31	210.00	2652.12	14.96	1.95
0163		14:57:46	215.00	2657.12	14.96	1.96
0164		14:58:01	218.00	2660.12	14.97	1.96
0165		14:58:16	222.00	2664.12	14.97	1.97
0166		14:59:01	224.00	2666.12	14.98	1.98
0167		14:59:46	229.00	2671.12	15.00	1.99
0168		15:00:46	227.00	2669.12	15.01	2.01
0169		15:01:01	223.00	2665.12	15.02	2.01
0170		15:01:16	220.00	2662.12	15.02	2.02
0171		15:01:31	218.00	2660.12	15.03	2.02
0172		15:02:01	216.00	2658.12	15.03	2.03
0173		15:04:01	214.00	2656.12	15.07	2.06
0174		15:05:31	216.00	2658.12	15.09	2.09
0175		15:06:01	218.00	2660.12	15.10	2.10
0176		15:07:31	221.00	2663.12	15.13	2.12
0177		15:08:16	223.00	2665.12	15.14	2.13
0178		15:08:31	220.00	2662.12	15.14	2.14
0179		15:09:01	222.00	2664.12	15.15	2.15
0180		15:12:46	222.00	2664.12	15.21	2.21
0181		15:14:46	220.00	2662.12	15.25	2.24
0182		15:15:46	217.00	2659.12	15.26	2.26
0183		15:18:01	219.00	2661.12	15.30	2.30
0184		15:21:01	216.00	2658.12	15.35	2.35
0185		15:23:31	214.00	2656.12	15.39	2.39
0186		15:24:31	216.00	2658.12	15.41	2.40
0187		15:25:01	218.00	2660.12	15.42	2.41
0188		15:25:31	215.00	2657.12	15.43	2.42
0189		15:25:46	218.00	2660.12	15.43	2.42
0190		15:27:01	215.00	2657.12	15.45	2.45
0191		15:27:16	217.00	2659.12	15.45	2.45
0192		15:28:16	214.00	2656.12	15.47	2.47
0193		15:28:31	216.00	2658.12	15.48	2.47
0194		15:29:16	213.00	2655.12	15.49	2.48
0195		15:30:01	215.00	2657.12	15.50	2.50
0196		15:33:46	217.00	2659.12	15.56	2.56
0197		15:35:01	214.00	2656.12	15.58	2.58
0198		15:35:46	216.00	2658.12	15.60	2.59
0199		15:39:16	214.00	2656.12	15.65	2.65
0200		15:40:01	212.00	2654.12	15.67	2.66

Location : BAY CITY, TEXAS  
Lease : BAY CITY WASTE DISPOSAL WELLS

Record	Date	Time	WHP	BHP	ELAPSED T	DELTA T
			Psia	PSIA	HOURS	HOURS
0201	10/31/90	15:42:01	214.00	2656.12	15.70	2.70
0202	Wednesday	15:42:31	216.00	2658.12	15.71	2.70
0203		15:42:46	220.00	2662.12	15.71	2.71
0204		15:43:01	218.00	2660.12	15.72	2.71
0205		15:43:16	216.00	2658.12	15.72	2.72
0206		15:44:16	214.00	2656.12	15.74	2.73
0207		15:46:16	217.00	2659.12	15.77	2.77
0208		15:46:46	215.00	2657.12	15.78	2.78
0209		15:47:31	213.00	2655.12	15.79	2.79
0210		15:48:01	215.00	2657.12	15.80	2.80
0211		15:48:46	217.00	2659.12	15.81	2.81
0212		15:51:46	219.00	2661.12	15.86	2.86
0213		15:52:31	217.00	2659.12	15.88	2.87
0214		15:54:16	219.00	2661.12	15.90	2.90
0215		15:54:46	217.00	2659.12	15.91	2.91
0216		15:55:16	215.00	2657.12	15.92	2.92
0217		15:56:16	217.00	2659.12	15.94	2.93
0218		15:56:46	219.00	2661.12	15.95	2.94
0219		15:58:01	221.00	2663.12	15.97	2.96
0220		16:01:46	223.00	2665.12	16.03	3.03
0221		16:03:31	225.00	2667.12	16.06	3.05
0222		16:04:01	223.00	2665.12	16.07	3.06
0223		16:05:16	221.00	2663.12	16.09	3.08
0224		16:09:01	222.00	2664.12	16.15	3.15
0225		16:09:16	220.00	2662.12	16.15	3.15
0226		16:13:01	221.00	2663.12	16.22	3.21
0227		16:16:01	223.00	2665.12	16.27	3.26
0228		16:19:46	222.00	2664.12	16.33	3.33
0229		16:21:16	224.00	2666.12	16.35	3.35
0230		16:22:01	221.00	2663.12	16.37	3.36
0231		16:22:16	223.00	2665.12	16.37	3.37
0232		16:22:46	221.00	2663.12	16.38	3.38
0233		16:25:01	223.00	2665.12	16.42	3.41
0234		16:28:46	223.00	2665.12	16.48	3.47
0235		16:30:16	225.00	2667.12	16.50	3.50
0236		16:32:46	223.00	2665.12	16.55	3.54
0237		16:36:31	224.00	2666.12	16.61	3.60
0238		16:39:46	226.00	2668.12	16.66	3.66
0239		16:41:31	223.00	2665.12	16.69	3.69
0240		16:44:01	221.00	2663.12	16.73	3.73
0241		16:47:46	220.00	2662.12	16.80	3.79
0242		16:48:46	222.00	2664.12	16.81	3.81
0243		16:51:01	220.00	2662.12	16.85	3.85
0244		16:53:31	222.00	2664.12	16.89	3.89
0245		16:56:46	220.00	2662.12	16.95	3.94
0246		16:57:46	222.00	2664.12	16.96	3.96
0247		16:59:31	220.00	2662.12	16.99	3.99
0248		17:00:31	222.00	2664.12	17.01	4.00
0249		17:01:46	220.00	2662.12	17.03	4.03
0250		17:02:31	218.00	2660.12	17.04	4.04

Location : BAY CITY, TEXAS

Lease : BAY CITY WASTE DISPOSAL WELLS

Record	Date	Time	WHP	BHP	ELAPSED T	DELTA T
			Psia	PSIA	HOURS	HOURS
0251	10/31/90	17:06:16	217.00	2659.12	17.10	4.10
0252	Wednesday	17:07:46	219.00	2661.12	17.13	4.12
0253		17:08:16	215.00	2657.12	17.14	4.13
0254		17:08:31	193.00	2635.12	17.14	4.14
0255		17:08:46	177.00	2619.12	17.15	4.14
0256		17:09:01	168.00	2610.12	17.15	4.15
0257		17:09:16	162.00	2604.12	17.15	4.15
0258		17:09:31	158.00	2600.12	17.16	4.15
0259		17:09:46	152.00	2594.12	17.16	4.16
0260		17:10:01	149.00	2591.12	17.17	4.16
0261		17:10:16	146.00	2588.12	17.17	4.17
0262		17:10:31	144.00	2586.12	17.18	4.17
0263		17:10:46	142.00	2584.12	17.18	4.18
0264		17:11:01	140.00	2582.12	17.18	4.18
0265		17:11:31	138.00	2580.12	17.19	4.19
0266		17:12:01	136.00	2578.12	17.20	4.20
0267		17:12:31	134.00	2576.12	17.21	4.20
0268		17:13:16	132.00	2574.12	17.22	4.22
0269		17:14:16	130.00	2572.12	17.24	4.23
0271		17:21:46	130.00	2572.12	17.36	4.36
0272		17:22:46	132.00	2574.12	17.38	4.38
0273		17:26:01	134.00	2576.12	17.43	4.43
0274		17:29:46	135.00	2577.12	17.50	4.49
0275		17:32:01	137.00	2579.12	17.53	4.53
0276		17:35:46	137.00	2579.12	17.60	4.59
0277		17:36:31	78.00	2520.12	17.61	4.60
0278		17:36:46	42.00	2484.12	17.61	4.61
0279		17:37:01	35.00	2477.12	17.62	4.61
0280		17:37:16	32.00	2474.12	17.62	4.62
0281		17:37:31	30.00	2472.12	17.63	4.62
0282		17:38:01	28.00	2470.12	17.63	4.63
0283		17:38:46	26.00	2468.12	17.65	4.64
0284		17:40:31	24.00	2466.12	17.68	4.67
0285		17:44:16	22.00	2464.12	17.74	4.73
0288		17:55:31	20.00	2462.12	17.93	4.92
0289		17:59:16	19.00	2461.12	17.99	4.98
0295		18:21:46	20.00	2462.12	18.36	5.36
0296		18:25:31	21.00	2463.12	18.43	5.42
0499	11/01/90	07:06:46	20.00	2462.12	31.11	18.11
0500	Thursday	07:10:31	19.00	2461.12	31.18	18.17
0505		07:29:16	19.00	2461.12	31.49	18.48
0506		07:31:16	16.00	2458.12	31.52	18.52
0509		07:42:31	15.00	2457.12	31.71	18.70
0510		07:45:31	19.00	2461.12	31.76	18.75
0511		07:45:46	24.00	2466.12	31.76	18.76
0512		07:46:01	32.00	2474.12	31.77	18.76
0513		07:46:16	48.00	2490.12	31.77	18.77
0514		07:46:31	77.00	2519.12	31.78	18.77
0515		07:46:46	108.00	2550.12	31.78	18.77
0516		07:47:01	119.00	2561.12	31.78	18.78

Location : BAY CITY, TEXAS

Lease : BAY CITY WASTE DISPOSAL WELLS

Record	Date	Time	WHP	BHP	ELAPSED T	DELTA T
			Psia	PSIA	HOURS	HOURS
0517	11/01/90	07:47:16	122.00	2564.12	31.79	18.78
0530	Thursday	08:36:01	123.00	2565.12	32.60	19.60
0531		08:37:01	111.00	2553.12	32.62	19.61
0532		08:37:16	127.00	2569.12	32.62	19.62
0533		08:37:31	122.00	2564.12	32.63	19.62
0534		08:37:46	125.00	2567.12	32.63	19.62
0535		08:38:01	127.00	2569.12	32.63	19.63
0536		08:38:16	129.00	2571.12	32.64	19.63
0537		08:39:01	131.00	2573.12	32.65	19.65
0538		08:39:46	133.00	2575.12	32.66	19.66
0539		08:41:01	135.00	2577.12	32.68	19.68
0540		08:42:01	141.00	2583.12	32.70	19.70
0541		08:42:16	143.00	2585.12	32.70	19.70
0542		08:42:31	145.00	2587.12	32.71	19.70
0543		08:43:16	147.00	2589.12	32.72	19.72
0544		08:43:46	149.00	2591.12	32.73	19.73
0545		08:44:16	151.00	2593.12	32.74	19.73
0546		08:45:01	153.00	2595.12	32.75	19.75
0547		08:46:46	155.00	2597.12	32.78	19.77
0548		08:48:01	157.00	2599.12	32.80	19.80
0549		08:48:31	159.00	2601.12	32.81	19.80
0550		08:49:01	161.00	2603.12	32.82	19.81
0551		08:51:16	163.00	2605.12	32.85	19.85
0552		08:52:46	161.00	2603.12	32.88	19.88
0553		08:54:31	158.00	2600.12	32.91	19.90
0554		08:54:46	156.00	2598.12	32.91	19.91
0555		08:55:16	153.00	2595.12	32.92	19.92
0556		08:55:31	151.00	2593.12	32.93	19.92
0557		08:56:01	149.00	2591.12	32.93	19.93
0558		08:59:46	149.00	2591.12	33.00	19.99
0559		09:02:01	151.00	2593.12	33.03	20.03
0560		09:02:46	153.00	2595.12	33.05	20.04
0561		09:03:16	151.00	2593.12	33.05	20.05
0562		09:03:31	149.00	2591.12	33.06	20.05
0563		09:04:16	147.00	2589.12	33.07	20.07
0564		09:05:31	145.00	2587.12	33.09	20.09
0565		09:08:16	143.00	2585.12	33.14	20.13
0566		09:12:01	144.00	2586.12	33.20	20.20
0567		09:14:31	142.00	2584.12	33.24	20.24
0568		09:16:01	144.00	2586.12	33.27	20.26
0569		09:19:46	145.00	2587.12	33.33	20.33
0570		09:22:01	143.00	2585.12	33.37	20.36
0571		09:22:31	145.00	2587.12	33.38	20.37
0572		09:24:16	143.00	2585.12	33.40	20.40
0573		09:25:31	145.00	2587.12	33.43	20.42
0574		09:29:16	145.00	2587.12	33.49	20.48
0575		09:32:01	143.00	2585.12	33.53	20.53
0576		09:32:16	146.00	2588.12	33.54	20.53
0577		09:32:31	143.00	2585.12	33.54	20.54
0578		09:32:46	145.00	2587.12	33.55	20.54

Location : BAY CITY, TEXAS  
Lease : BAY CITY WASTE DISPOSAL WELLS

Record	Date	Time	WHP	BHP	ELAPSED T	DELTA T
			Psia	PSIA	HOURS	HOURS
0579	11/01/90	09:33:16	140.00	2582.12	33.55	20.55
0580	Thursday	09:33:46	142.00	2584.12	33.56	20.56
0581		09:34:46	144.00	2586.12	33.58	20.58
0582		09:35:16	138.00	2580.12	33.59	20.58
0583		09:35:46	145.00	2587.12	33.60	20.59
0584		09:36:31	147.00	2589.12	33.61	20.60
0585		09:37:01	149.00	2591.12	33.62	20.61
0586		09:37:46	151.00	2593.12	33.63	20.62
0587		09:38:31	153.00	2595.12	33.64	20.64
0588		09:39:16	155.00	2597.12	33.65	20.65
0589		09:40:31	157.00	2599.12	33.68	20.67
0590		09:44:16	158.00	2600.12	33.74	20.73
0591		09:46:01	156.00	2598.12	33.77	20.76
0592		09:48:16	154.00	2596.12	33.80	20.80
0593		09:50:01	152.00	2594.12	33.83	20.83
0594		09:51:31	150.00	2592.12	33.86	20.85
0595		09:54:16	152.00	2594.12	33.90	20.90
0596		09:58:01	152.00	2594.12	33.97	20.96
0597		09:58:46	154.00	2596.12	33.98	20.98
0598		10:00:46	156.00	2598.12	34.01	21.01
0599		10:01:46	154.00	2596.12	34.03	21.02
0600		10:04:01	156.00	2598.12	34.07	21.06
0602		10:11:31	157.00	2599.12	34.19	21.19
0603		10:12:31	155.00	2597.12	34.21	21.20
0604		10:14:01	157.00	2599.12	34.23	21.23
0605		10:16:01	155.00	2597.12	34.27	21.26
0606		10:19:46	156.00	2598.12	34.33	21.33
0607		10:21:46	158.00	2600.12	34.36	21.36
0608		10:24:46	160.00	2602.12	34.41	21.41
0609		10:25:16	158.00	2600.12	34.42	21.42
0610		10:25:46	156.00	2598.12	34.43	21.42
0611		10:26:46	158.00	2600.12	34.45	21.44
0612		10:28:16	154.00	2596.12	34.47	21.47
0613		10:28:31	156.00	2598.12	34.48	21.47
0614		10:30:01	159.00	2601.12	34.50	21.50
0615		10:32:01	157.00	2599.12	34.53	21.53
0616		10:32:16	163.00	2605.12	34.54	21.53
0617		10:32:31	160.00	2602.12	34.54	21.54
0618		10:33:01	157.00	2599.12	34.55	21.55
0619		10:33:16	162.00	2604.12	34.55	21.55
0620		10:33:31	157.00	2599.12	34.56	21.55
0621		10:34:01	159.00	2601.12	34.57	21.56
0622		10:34:46	161.00	2603.12	34.58	21.58
0623		10:36:31	153.00	2595.12	34.61	21.60
0624		10:36:46	158.00	2600.12	34.61	21.61
0625		10:40:31	162.00	2604.12	34.68	21.67
0626		10:41:31	165.00	2607.12	34.69	21.69
0627		10:41:46	167.00	2609.12	34.70	21.69
0628		10:42:16	165.00	2607.12	34.70	21.70
0629		10:43:16	167.00	2609.12	34.72	21.72

Location : BAY CITY, TEXAS

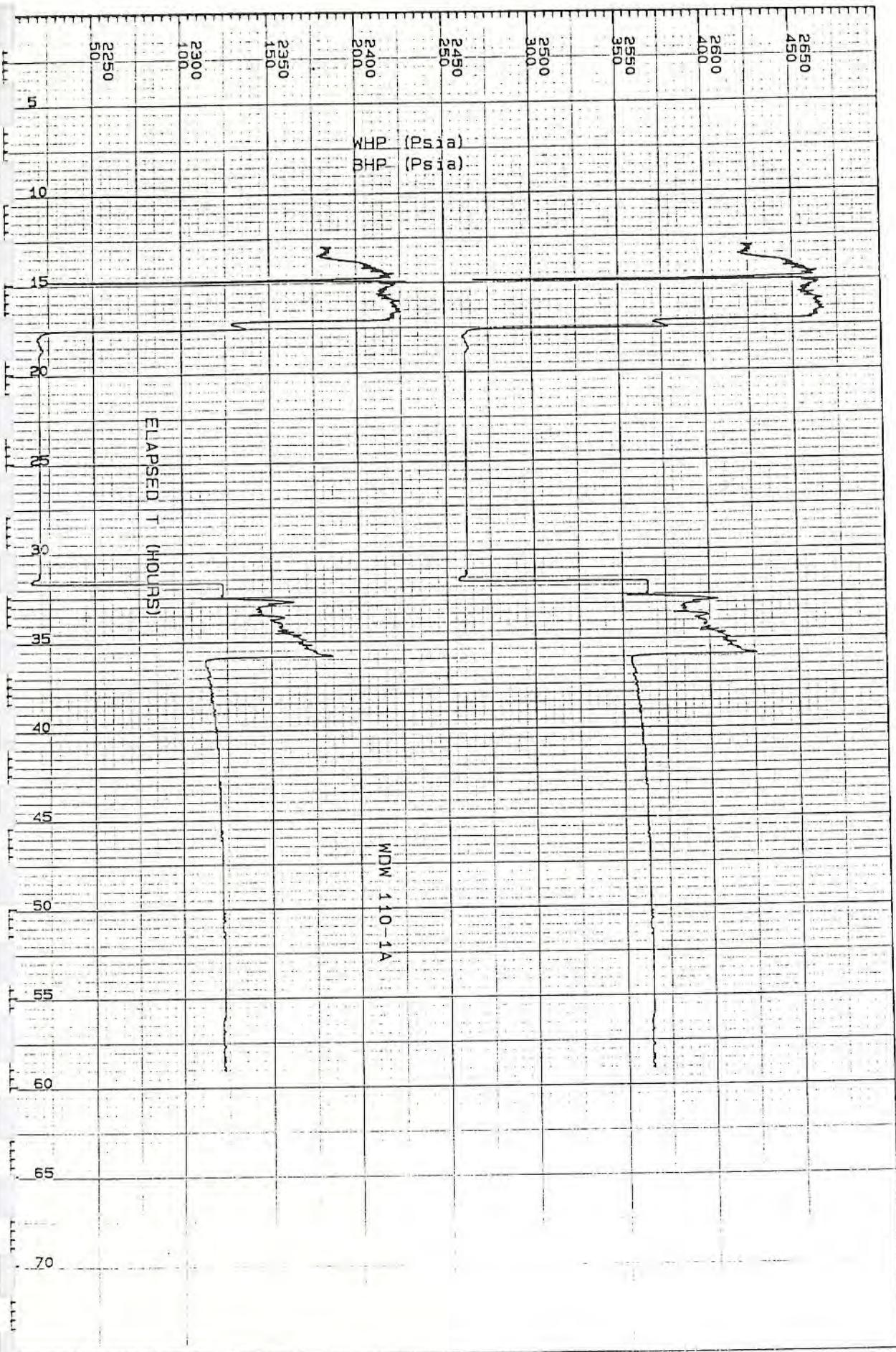
Lease : BAY CITY WASTE DISPOSAL WELLS

Record	Date	Time	WHP	BHP	ELAPSED T	DELTA T
			Psia	PSIA	HOURS	HOURS
0630	11/01/90	10:45:16	165.00	2607.12	34.75	21.75
0631	Thursday	10:46:46	163.00	2605.12	34.78	21.77
0632		10:47:46	165.00	2607.12	34.80	21.79
0634		10:55:16	167.00	2609.12	34.92	21.92
0635		10:58:46	170.00	2612.12	34.98	21.98
0636		10:59:01	168.00	2610.12	34.98	21.98
0637		11:02:46	168.00	2610.12	35.05	22.04
0638		11:05:01	166.00	2608.12	35.08	22.08
0639		11:06:01	168.00	2610.12	35.10	22.10
0640		11:09:46	168.00	2610.12	35.16	22.16
0641		11:11:16	166.00	2608.12	35.19	22.18
0642		11:13:01	168.00	2610.12	35.22	22.21
0643		11:16:16	173.00	2615.12	35.27	22.27
0644		11:16:31	168.00	2610.12	35.28	22.27
0645		11:16:46	170.00	2612.12	35.28	22.27
0649		11:28:31	171.00	2613.12	35.48	22.47
0650		11:32:01	173.00	2615.12	35.53	22.53
0651		11:34:31	175.00	2617.12	35.58	22.57
0652		11:38:16	176.00	2618.12	35.64	22.63
0653		11:38:46	174.00	2616.12	35.65	22.64
0654		11:39:46	176.00	2618.12	35.66	22.66
0655		11:43:31	176.00	2618.12	35.73	22.72
0656		11:47:16	178.00	2620.12	35.79	22.78
0657		11:47:46	180.00	2622.12	35.80	22.79
0658		11:49:16	182.00	2624.12	35.82	22.82
0659		11:50:01	184.00	2626.12	35.83	22.83
0660		11:52:46	179.00	2621.12	35.88	22.88
0661		11:53:01	183.00	2625.12	35.88	22.88
0662		11:53:31	185.00	2627.12	35.89	22.89
0663		11:54:16	183.00	2625.12	35.90	22.90
0664		11:54:46	159.00	2601.12	35.91	22.91
0665		11:55:01	148.00	2590.12	35.92	22.91
0666		11:55:16	144.00	2586.12	35.92	22.92
0667		11:55:31	138.00	2580.12	35.93	22.92
0668		11:55:46	136.00	2578.12	35.93	22.92
0669		11:56:01	133.00	2575.12	35.93	22.93
0670		11:56:16	131.00	2573.12	35.94	22.93
0671		11:56:46	128.00	2570.12	35.95	22.94
0672		11:57:01	126.00	2568.12	35.95	22.95
0673		11:57:31	124.00	2566.12	35.96	22.95
0674		11:58:01	122.00	2564.12	35.97	22.96
0675		11:58:31	120.00	2562.12	35.98	22.97
0676		11:59:16	118.00	2560.12	35.99	22.98
0677		12:00:31	116.00	2558.12	36.01	23.00
0678		12:02:31	114.00	2556.12	36.04	23.04
0688		12:40:01	114.00	2556.12	36.67	23.66
0689		12:43:46	115.00	2557.12	36.73	23.73
0708		13:53:01	116.00	2558.12	37.88	24.88
0709		13:56:46	117.00	2559.12	37.95	24.94
0723		14:49:16	117.00	2559.12	38.82	25.82

Location : BAY CITY, TEXAS

Lease : BAY CITY WASTE DISPOSAL WELLS

Record	Date	Time	WHP	BHP	ELAPSED T	DELTA T
			Psia	PSIA	HOURS	HOURS
0724	11/01/90	14:53:01	118.00	2560.12	38.88	25.88
0758	Thursday	17:00:31	119.00	2561.12	41.01	28.00
0759		17:04:16	120.00	2562.12	41.07	28.07
0832		21:38:01	121.00	2563.12	45.63	32.63
0833		21:41:46	122.00	2564.12	45.70	32.69
0906	11/02/90	02:15:31	122.00	2564.12	50.26	37.25
0907	Friday	02:19:16	123.00	2565.12	50.32	37.32
1048		11:08:01	123.00	2565.12	59.13	46.13



APPENDIX E  
REGULATORY CORRESPONDENCE





*B 11*

Golden Strataservices, Inc.

711 Louisiana • Suite 1600 • Houston, Texas 77002 • 713/222-9600

J90065

October 8, 1990

Texas Water Commission  
Underground Injection Control Section  
P.O. Box 13087  
Austin, Texas 78711

Attn: Mr. Richard Merritt

Re: Hoechst Celanese Bay City, Texas- Ambient Monitoring  
Procedures

Dear Mr. Merritt,

In an effort to reduce the cost and risk of ambient monitoring at Hoechst-Celanese Corporation's (HCC) Bay City facility, Golden StrataServices, Inc. (GSS) proposes to record surface pressures in lieu of bottom hole pressures to satisfy the ambient monitoring requirements on both WDW-14 and WDW-110. The surface pressure coupled with the injection of a known specific gravity fluid into the wellbore will yield a calculated formation pressure.

GSS proposes to utilize the highly accurate Self-Powered Intelligent Data Retriever (SPIDR), manufactured by Data Retrieval Corporation (DRC), to record the wellhead pressure during both the injection and fall-off periods. In essence, the SPIDR (see attached DRC brochure) will be installed on the wellhead and surface injection pressure will be recorded while the well is in service. After several hours, the well will be taken out of service and the fall-off pressure will also be recorded. All pressure will be recorded with a known density fluid in the wellbore, the wastestream. The estimated static surface pressure, post fall-off, is approximately 80 psig on both WDW-14 and WDW-110.

After the completion of the field operations, the SPIDR will be returned to DRC for the processing of the raw data. DRC will then convert the surface pressures to bottom hole pressures using DRC software and submit a final report for inclusion in HCC's mechanical integrity report.

If you have any questions in regards to the aforementioned,  
pleased do not hesitate to call me at (713) 222-9600.

Respectfully,



Robert M. Hall  
Operations Specialist

cc: w\attachments  
Ray Horton, HCC  
Thomas Jones, GSS

# NEW DO-IT-YOURSELF SYSTEM MAKES FREQUENT PRESSURE-TRANSIENT TESTING PRACTICAL.

Results duplicate those from  
expensive, risky bottom-hole tests.

Now you can get accurate pressure-transient test information without calling in a service company and without running tools and gauges downhole.

A new pressure-transient test system makes it very easy for you to do the test yourself. The system includes hardware that records pressures and flowrates at the wellhead and proprietary report generator software that calculates the results and plots all the reservoir analysis curves you need. The calculations and curves you get can be matched only by the most sophisticated testing service companies. But, because you own the hardware and software and can use it again and again, your testing costs will be a fraction of what they were. The more you use the system, the smaller the fraction. Or, you can rent the hardware for less than \$200 per day and let Data Retrieval Corp. handle the programming and report generation. That means you can now test more wells, more often—even low-permeability and marginal wells—to do a better job of reservoir management. The system is used for drawdown tests on condensate-rich gas wells or for build-up tests on dry gas wells where fluid level in the tubing doesn't change during the test.

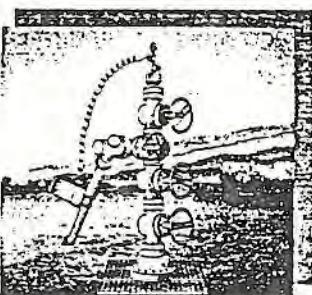
## The amazing SPIDR™ collects the data.

The Self-Powered Intelligent Data Retriever (SPIDR) is a battery-powered computer combined with a self-compensating, high-precision pressure transducer that measures pressures at the wellhead accurately regardless of ambient temperature changes. You can install the SPIDR at the wellhead using simple hand tools. Capillary tubing runs from the SPIDR to a connection at the wellhead pressure gauge. If flowrate changes are to be recorded, the SPIDR can simultaneously accept input from a differential-pressure transducer.

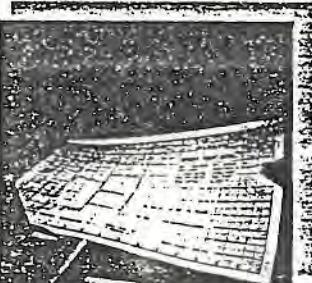
Using a Hewlett-Packard HP-41 hand-held calculator, you program the SPIDR for the test telling it when to start sampling, how often to sample, and the minimum change to be recorded (sample window). The SPIDR will then operate unattended, collecting up to 100 readings. A fresh set of ordinary D-cell batteries will operate the SPIDR for 120,000 samples.



The SPIDR: Computer and pressure transducer in a rugged, oilfield housing. Use an HP-41 calculator to set up the sampling program and to download raw pressure and flowrate data. Standard D-cell batteries power the unit for up to 2 years.



The SPIDR installed at the wellhead. Clamp it in any position or orientation and connect the capillary tubing at the wellhead pressure gauge. Standard wrenches are all you need.



The SPRG report generator is an IBM-compatible, menu-driven software program that performs all the calculations, generates a columnar report, and drives a plotter to generate linear, semi-log and log-log reservoir-analysis curves.

## Powerful SPRG™ software generates the report.

At the end of a test, you simply reconnect the HP-41 calculator to the SPIDR, download the data, take the HP-41 back to your office, and upload the data into a personal computer (IBM or IBM-compatible) that contains the SPIDR Report Generator (SPRG) software. In a couple of hours, you'll have your rigorously calculated results and accurately plotted reservoir-analysis curves.

The SPRG program converts the wellhead pressures to bottom-hole pressures using a modified Cullender-Smith routine. Then, using program sub-routines—or your own subroutines—it calculates whatever information is needed: pseudopressures, delta time, delta pressure, cumulative production, Horner time, critical pressure, critical temperature, and gas gravity. You can then plot any two parameters against each other to create reservoir-analysis curves—linear, semi-log, or log-log.

## A hassle-free, free trial.

Judge the SPIDR/SPRG system for yourself. Give us the basic data for any well and we'll program a SPIDR and ship it to you with all necessary fittings. Install it on your well, conduct the pressure-transient test, then send the SPIDR back to us. We'll send you the finished report. That's all there is to it. If you put the SPIDR on a well being tested by conventional downhole methods, you'll see that the SPIDR/SPRG system is every bit as accurate as the more expensive and riskier downhole methods.

Call us, or write to us on your letterhead, and we'll give you additional information and arrange the free trial.



## Data Retrieval Corporation

5625 FM 1960 West

Suite 502

Houston, Texas 77069

(713) 444-5398

# SPIDR® APPLICATIONS



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A summary of the many oilfield applications  
of the Self-Powered Intelligent Data Retriever (SPIDR)  
from Data Retrieval Corporation.

---



*Data Retrieval Corporation*

5625 FM 1960 W, Suite 502  
Houston, Texas 77069  
Phone: 713/444-5398  
Fax: 713/444-5397

## SPIDR DESCRIPTION

The SPIDR is a portable data acquisition device that weighs only seven pounds and is powered by three ordinary alkaline "D" cell batteries that can operate the unit for up to two years. The SPIDR contains an integral temperature-compensated pressure transducer that measures pressures via oil-filled capillary tubing. There is also an electrical connection for use with any of four types of external transducers: temperature, pressure, differential pressure (for gas flow rates), or turbine meter pulses (for liquid flow rates). The SPIDR can be programmed to operate in either the single-channel mode (internal pressure transducer) or dual-channel mode (internal plus an external transducer). The external transducer can be located remote from the SPIDR, limited only by the length of the connecting cable.

The SPIDR, by itself or in combination with an external transducer, can be used in many different applications. Its low cost, high reliability, and ease of use make it a logical choice for testing gas wells, flowing or pumping oil wells, geothermal wells, and storage caverns for fuels, chemicals, and air. The fact that the SPIDR does not require going downhole eliminates the risk of lost tools, fishing jobs, and exposure to sour or acid gases. This booklet describes some of the most frequent uses of the SPIDR.

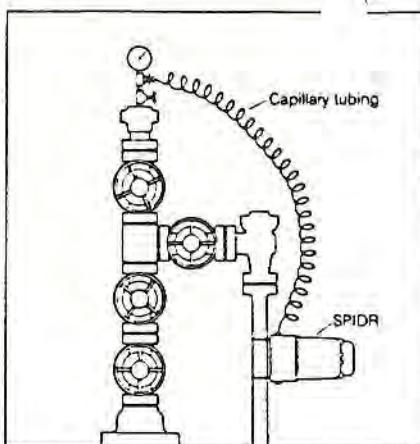


Figure 1

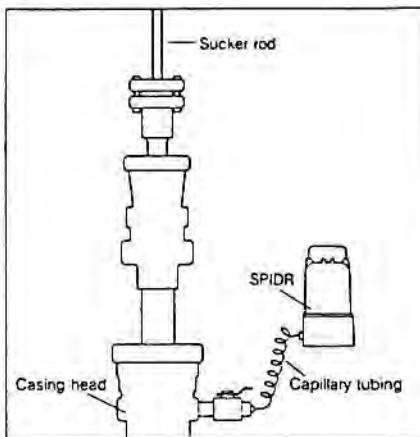


Figure 2

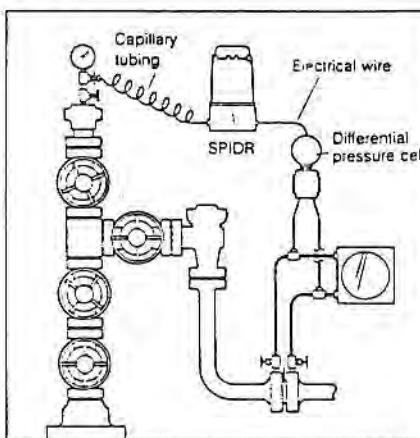


Figure 3

### Build-up tests

Build-up testing is probably the most common type of pressure transient test. It requires shutting in a well and monitoring the change in pressure against time. It is used to determine the degree of skin damage to the well-bore and to evaluate the permeability of the reservoir. If liquid level changes occur in the well during the build-up, a liquid level sounding device is used to monitor the level changes so the build-up curve may be corrected. Draw-down tests are also recommended where liquid level changes occur during build-up. The SPIDR is normally connected to the well between the needle valve and the pressure gauge as shown in Figure 1. For packerless completions such as pumping oil wells, the SPIDR is connected to the casing bleed-off valve as shown in Figure 2. In either case, external transducers are not necessary.

### Draw-down tests

Draw-down tests will yield the same information as build-up tests, but are usually run on new wells or to determine reservoir limits. Draw-down testing requires monitoring of production rate as well as pressure. For gas wells, the SPIDR is configured as shown in Figure 3. The external transducer is a differential pressure cell which is connected across the orifice plate and in parallel with the two-pen recorder. The two-pen recorder continues to function normally. The line pressure and orifice-plate coefficient are programmed into the SPIDR to enable it to compute flow. Flow from an oil well can be monitored if there is a turbine meter in the flow line. The DRC turbine meter interface is then connected as shown in Figure 4 and the meter coefficient is programmed into the SPIDR. With gas or liquids, the flow rate can be read directly using an HP-41 calculator connected to the SPIDR.

### Deliverability testing

Deliverability tests, also called 4-point tests, are often required by regulatory agencies and gas transmission companies. These tests require that a well be produced at four stable rates in either increasing or decreasing steps. The purpose of the test is to estimate the maximum theoretical rate at which the reservoir would produce if there were no restrictions to flow. The SPIDR is connected to the well as shown in Figure 3.

## Isochronal testing

This type of testing is a modified form of deliverability testing in which there are build-up periods of fixed duration between each flow period. Isochronal testing is used on low permeability reservoirs where the time required to reach stable flow, as required in deliverability testing, is prohibitive. The SPIDR is connected to the well as shown in Figure 3.

## Step-rate testing

The objective of step-rate testing is to identify the injection pressure at which the formation will fracture. Fluid, usually water, is injected into the formation at increasing rates while monitoring both rate and pressure. When an increase in rate is not accompanied by a corresponding increase in pressure, fracture pressure has been reached. The SPIDR is connected to the well as shown in Figure 4. Note, however, that the direction of flow will be into the well.

## Production monitoring

The SPIDR may be used for long-term production monitoring. By connecting the SPIDR as shown in Figure 3, decline curves may be constructed. The SPIDR software allows calculation and plotting of cumulative production versus P/Z.

## Injection fall-off tests

The injection fall-off test is similar to a build-up test in that pressure change with time is monitored after flow ceases. The difference is that the flow is to the well rather than from the well. The test objectives are determination of skin and permeability. Injection fall-off tests can be performed on disposal wells, CO<sub>2</sub> injections, combustion gas injections, and polymer or water floods.

For gas injection fall-offs, the SPIDR is connected as in Figure 3.

For liquid injection fall-offs, the SPIDR is connected as in Figure 4.

## Packer leakage tests/zone communication tests

Many regulatory agencies require packer leakage tests to confirm isolation of tubing from the annulus or to confirm non-communication between zones. For packer leakage tests, the SPIDR and an external pressure transducer are connected as shown in Figure 5. Testing for communication between zones on a dual completion well is accomplished by connecting a SPIDR and an external pressure transducer as shown in Figure 6.

## Well communication tests

Communication testing is used to determine if two wells are in the same reservoir. The test is usually run by pulsing a producing well; i.e. shutting in for one hour every other hour for two or three pulses while monitoring a non-flowing "watch" well. The SPIDR is ideal for this application due to its sensitivity and stability, regardless of ambient temperature changes. The time required for the pulses to reach the watch well may be computed from the reservoir permeability and the distance between the wells. The SPIDR is connected to the watch well as shown in Figure 1.

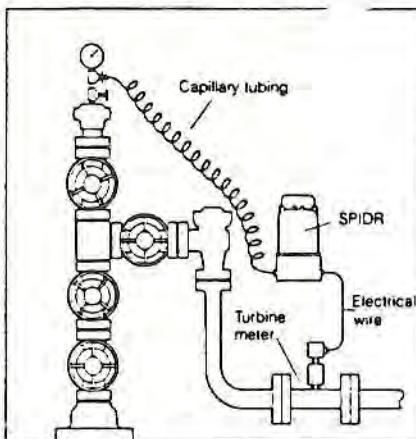


Figure 4

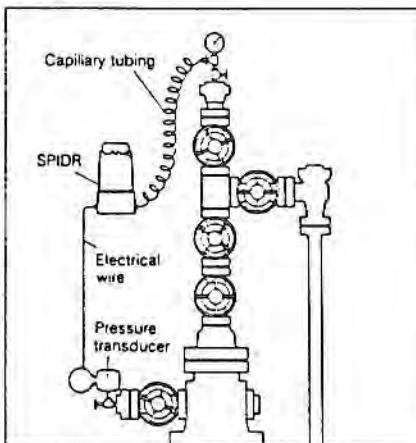


Figure 5

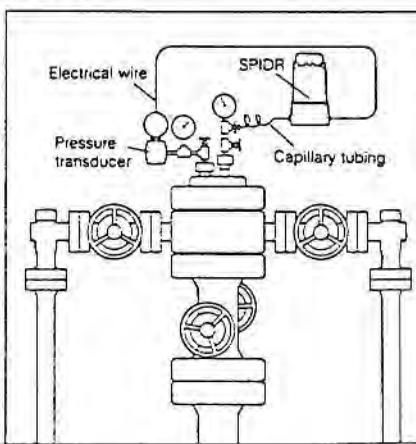


Figure 6

## Downhole pressures via chemical injection lines

Some wells employ chemical injection systems that use a small diameter tube strapped to the outside of the production string. The chemical is then pumped through the tube to the bottom of the well. A SPIDR, installed as shown in Figure 7, will monitor a pressure that is equal to the bottom-hole pressure minus the hydraulic head of the chemical being injected. With this system, it should never be necessary to run pressure bombs downhole.

## Downhole pressures via capillary systems

On wells in which it is impractical to run pressure bombs downhole, capillary tubing is fixed to the outside of the production string and connects to a chamber at the bottom of the well. Helium gas is then pumped into the tubing until all fluid is displaced from the system. A SPIDR connected to the top of the tubing, as shown in Figure 8, monitors the bottom-hole pressure, corrected for the column of helium.

## Gas-meter prover

The SPIDR in combination with a differential pressure cell can be used as a portable recording flow meter. The SPIDR and differential pressure cell are connected as shown in Figure 9. The SPIDR is programmed with the orifice plate coefficient and measures both line pressure and differential pressure. The SPIDR software calculates flow rate which can be plotted versus time and will also integrate flow for cumulative production.

## Flood monitor

During polymer or water floods, it is sometimes necessary to change the location of the injection wells. The progress and direction of the flood through the reservoir is followed using SPIDRs installed on "watch" wells. The SPIDR is attached to the watch wells as illustrated in Figure 1. When the pressure front becomes irregular, the location of the injection wells can be changed.

## SPIDR SPECIFICATIONS

Full scale pressure .....	0-10,000 PSI.
Maximum pressure .....	150% of rated range.
Resolution .....	0.1 PSI (3,277 PSI maximum) 1.0 PSI (15,000 PSI maximum)
Accuracy .....	$\pm 0.01\%$ of F.S., $\pm 1$ count including linearity, hysteresis & repeatability.
Operating temperature range .....	0-180°F.
Temperature compensation .....	Indicated pressures not affected by ambient temperature changes within the operating temperature range.
Maximum memory capacity .....	8,000 data sets in single-channel mode and 4,000 data sets in dual-channel mode (memory equivalent to 64,000 bytes).
External transducers ....	10 V @ 1 mA D.C. supply with 0.8-3.2 V signal. Available for pressure, differential pressure, temperature, and turbine flow-meters.
Interface .....	Hewlett-Packard interface loop (HP-IL).
Power .....	3 alkaline "D" cells providing 2-year operating life.
Pressure fitting .....	1/16-in. Swagelock (standard).
Dimensions .....	5 3/4 in. x 5 3/4 in. x 9 in.
Weight .....	7 pounds
Housing .....	Modified Class 1, Group D enclosure with chemical-resistant finish.
Data storage .....	Programmable sample rate and acceptance criteria. Data acceptance based on pressure change.

Copyright 1987 Data Retrieval Corporation

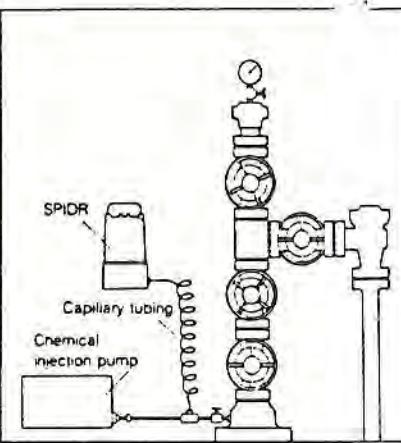


Figure 7

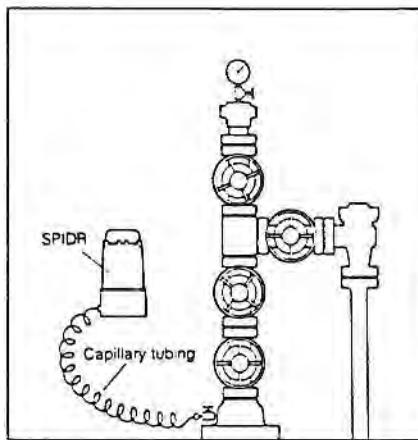


Figure 8

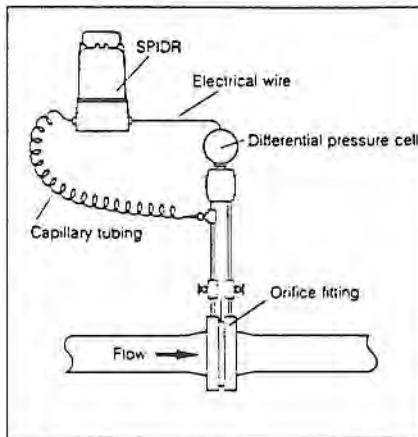


Figure 9

Interoffice Memo

Rev. 10-24-76

Hoechst Celanese

**FILE COPY**

Date: October 15, 1990

IOC-313-90

To: H. R. Horton

From: I. O. Coleman, Jr.

Dept/Location: Bay City Plant

Dept/Location: Bay City Plant

Subject: Texas Water Commission (TWC) Approval of Proposed  
Mechanical Integrity Testing of Bay City Plant Injection  
Wells (Reference Letter, IOC-298-90, Dated October 10, 1990)

cc: C. R. Pennington - w/o Attach.  
B. L. Fritz - w/o Attach  
G. E. Organ ---> Environmental File 203.13  
H. P. Heathman - w/o Attach  
W. G. Cornman - " "  
R. S. O'Neal - " "  
G. J. McCarthy  
R. D. Riley  
B. A. Logue ---> E. A. Wilson  
E. H. Chiu ---> M. L. Harvel  
R. H. Maurer - Dallas  
G. M. Rowen - Bridgewater  
R. W. Hall - (Golden StrataServices) Houston

The following documents are attached and provided for your information:

- Addendum I      TWC Letter, dated October 15, 1990 documenting approval of the proposed procedures for conducting mechanical integrity testing (MIT) on our injection wells.
- Addendum II      Revised (09-01-90) TWC "Basic Guidelines For Mechanical Integrity Test And Related Cased Hole Wireline Logging".
- Addendum II      Above: (1) stipulates the minimum procedures for conducting the various tests associated with MIT and (2) summarized the minimum contents of the report which is required to be submitted to TWC within 30 days upon completion of testing.

Mr. R. W. Hall, Golden StrataServices (GSS) Inc., is on the distribution list of this letter. It is my understanding that GSS will generate the above report.

As you are aware, Mr. Richard Merritt (TWC) will be on site to observe the testing for Monday through Wednesday, October 29 - 31, 1990.

IOC-313-90

Page 2

Please contact me if you have any problems, comments and/or questions about the additional requirements TWC has requested for inclusion in the MIT procedures.

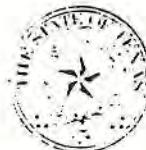
*I. O. Coleman, Jr.*  
I. O. Coleman, Jr.

IOC/1a

Attachment

APPENDIX I  
**TEXAS WATER COMMISSION**

B. J. Wynne, III, Chairman  
John E. Birdwell, Commissioner  
Cliff Johnson, Commissioner



John J. Vay, General Counsel  
Michael E. Field, Chief Hearings Examiner  
Brenda W. Foster, Chief Clerk

Allen Beinke, Executive Director  
October 15, 1990

Mr. I. O. Coleman, Jr.  
Environmental Affairs Section Leader  
Hoechst Celanese Chemical Group, Inc.  
Bay City Plant  
P. O. Box 509  
Bay City, Texas 77404-0509

Re: Approval of Proposed Mechanical Integrity Testing, TWC  
Permit No. WDW-14, WDW-32, WDW-49 and WDW-110

Dear Mr. Coleman:

The staff has reviewed your request for mechanical integrity testing of the above referenced well and finds that it will meet the requirements outlined in 31 TAC §§ 331.43 and 331.64.d. with the following addition:

Please note the "T.W.C. Basic Guidelines for Mechanical Integrity Tests" (Revised 9-1-90) stipulates that the tool remain above the radioactive slug as it proceeds downhole during the moving survey portion of the RAT.

Pursuant to 31 TAC § 331.65.b.4., within 30 days of completion of the testing, please submit a report to the executive director containing, at a minimum, the following information:

1. A complete chronology and description of all tests performed and procedures followed;
2. An APT time/pressure table, and a copy of the recorder chart if one was made;
3. Copies of all logs run;
4. Interpretation and discussion of all testing and logging results, including the identity of personnel making the technical interpretations; and
5. Certification by the individual preparing the reports that all test data is true and correct, and that the test procedures followed were submitted to, and received prior approval from the TWC UIC Unit.

Mr. I. O. Coleman, Jr.  
Page 2

ADDENDUM 1 (CONT'D)

If you have any questions, please contact Mr. Richard Merritt of my staff at 512/463-8139.

Sincerely,

*Minor Brooks Hibbs*

Minor Brooks Hibbs, Chief  
Hazardous and Solid Waste Permits Section  
Hazardous and Solid Waste Division

RM/

Enclosures

cc: T.W.C. District 7 Office - Houston  
Brian Graves, U.S.E.P.A. - Region VI (6WSU)

TEXAS WATER COMMISSION  
CLASS I UNDERGROUND INJECTION CONTROL

BASIC GUIDELINES FOR MECHANICAL INTEGRITY TESTS  
AND RELATED CASED HOLE WIRELINE LOGGING

As stated in 31 TAC 331.43(a): "An injection well has mechanical integrity if there is no significant leak in the casing, tubing or packer, and if there is no significant fluid movement through vertical channels adjacent to the injection wellbore." The Texas Water Commission (TWC) requires an annual demonstration of mechanical integrity for all Class I wells, and also after any operations which involve removal of the injection tubing, recompletions, or unseating of the packer.

The tests normally required by the TWC to demonstrate mechanical integrity are an annulus pressure test and a radioactive tracer survey. In addition, a cement bond log, a casing inspection or evaluation log, and a temperature or noise log are required for newly constructed wells. These may also be required as part of the routine annual MIT in certain instances. A temperature or noise log is required every five years, and a casing inspection or evaluation log may be required every five years at the discretion of the TWC. The TWC will request that a casing inspection or evaluation log be run during workovers where the injection tubing is pulled if none has been run in the previous five years.

The following procedures are recommended for the purpose of standardizing the testing throughout the Texas Class I Underground Injection Control (UIC) program, and also to insure that an adequate demonstration of mechanical integrity is achieved. Changes or deviations from any of the procedures below, or the use of alternate MIT demonstrations, will be decided on a case-by-case basis by the TWC UIC Unit. Using other procedures or tests without obtaining prior TWC review and approval could result in an unsatisfactory demonstration of mechanical integrity.

General

All wireline logs shall be run on API paper and shall be formatted according to the standard practice of the petroleum logging industry in the region. For quality control purposes, all appropriate log header entries shall be completely filled in and all curves shall have repeat sections. All curves and scales on the log itself shall be clearly labeled. Though the vertical and horizontal scales should normally be set as outlined below, if any of the logs below have previously been run subsequent logs may be scaled the same as them.

All logs shall have depth correlation curves recorded in track 1. These would typically be natural gamma radiation and/or casing collar locator logs (preferably both). Gamma correlation curves should be run at 100 or 150 API units per track. Vertical depth scale for all logs should be 5 inches per 100 feet to facilitate correlations with open hole and other logs. Logs run on time drive should be scaled at 1 inch or more per minute.

For hazardous waste disposal wells, waste fluids shall be flushed from the well prior to any operations which have the potential for exposure of the wastes to the environment or to the public. It is recommended that non-hazardous brines be used for any well testing involving injection.

All testing, log analyses, and technical interpretations shall be done by personnel with the qualifications and experience required to competently perform these tasks.

Annulus Pressure Tests (APT)

The APT shall consist of holding a positive annulus pressure differential over tubing pressure for a minimum of 30 minutes, with a loss or buildup of no more than 5% of the start pressure. The pressure differential held shall be:

1. 1000 psig, or (subject to prior approval)
2. 80% of the rated collapse pressure of the injection tubing, or
3. 200% of the permitted maximum allowable surface injection pressure.

If the test is not witnessed by a TWC representative, pressures shall be recorded on a time-drive recorder, and the chart shall be certified as true and accurate. The pressure scale on the chart should be low enough to readily show a 5% change from the starting pressure. If the test is witnessed by TWC personnel, chart recording is recommended but not required.

Radioactive Tracer Survey (RAT)

The preferred technique would be to use a logging tool with a gamma detector above the ejector port and one or two below it. The tool should be able to continuously record during tracer fluid ejection. The upper detector would be recorded in track 1 at a scale of 0 to 100 or 150 API units. The lower detector(s) would be recorded in tracks 2 and 3 at a higher scale, typically 0 to 1000 API units.

Prior to testing, an initial gamma ray log shall be recorded from at least 100 feet above the injection tubing packer to:

1. at least 100 feet below the lowest perforated interval, or
2. TD/PBTD of the well, or



3. the top of fill or obstructions, or
4. the top of the screen,

whichever is lowest. A concurrent casing collar locator log is recommended. This log is for the purpose of correlations and determining background radiation prior to tracer fluid ejection.

During the survey, injection flow rates should be set at the maximum rate at which the fluid will be under laminar flow, while remaining within the maximum permitted operating parameters. The volume of the tracer fluid slug should be sufficient to cause a gamma curve deflection of at least 25x background reading as the ejected slug passes the lower detector(s). This would typically be a full-scale deflection.

A moving survey shall be run from the packer to the perforations or screen to check for leaks between those two points. This survey shall consist of ejecting a slug within the packer or tailpipe, verifying the ejection, and then logging down on depth drive as the tool stays above the slug and follows it down.

A stationary survey shall be run approximately 20 feet or less above the top of the perforated interval or the screen to check for upward fluid migration outside the cemented casing. If this depth cannot be reached due to fill or obstructions, the log should be run at the lowest possible depth. The procedure is to log on time drive, eject a slug, verify the ejection, and wait an appropriate amount of time to allow the slug to exit the wellbore and return through channels outside pipe. The time spent at the station will vary but should be at least twice the time estimated to detect the tracer fluid if channeling existed.

If a satisfactory APT has not been performed in conjunction with the RAT survey, an additional stationary survey shall be run approximately 20 feet or less above the injection tubing packer to check for u-tubing of fluids into the annulus. There shall be no pressure at the wellhead on the annulus when this test is performed.

Other stationary or moving surveys may be required depending on test results, or to investigate previously known problems conditions. At least two repeatable logs of every tracer survey moving and stationary, shall be run. On completion of the trace surveys, a final background gamma log shall run for comparison with the initial background log.

One or more of the following logs may periodically required as part of an MIT, or other well testing program.

#### Cement Bond Log (CBL)

The CBL is for the purpose of evaluating cement condition after well construction and over time. It shall be run over



entire interval of cemented casing. The log shall consist of a minimum of a casing collar log (preferably with a natural gamma curve) for correlation purposes, amplitude and travel time curves, and an acoustic variable density log (VDL).

The recommended format is to record the correlation log(s) in track 1, the acoustic curves in track 2, and the VDL in track 3. This is a standard format in the logging industry, but other formats or techniques unique to an individual wireline logging company may be used subject to prior review and approval.

The wireline logging engineer shall be provided with a simulated or actual free pipe section for the bond tool calibration unless it can be shown that the tool does not require a free pipe calibration for equipment setup.

#### Temperature Log

The temperature log is one of the acceptable logs for detecting fluid movement outside pipe. It shall include both an absolute temperature curve and a differential temperature curve. The well should be shut-in at least 36 hours to allow for temperature stabilization, though a shorter time period may be approved at the discretion of the TWC UIC Unit.

The log shall be run over the entire interval of cemented casing, logging down from the surface to TD. A correlation log(s) shall be recorded in track 1, and the two temperature curves recorded in tracks 2 and 3. The temperature log should be scaled at or about 20° F or 10° C degrees per track. The differential curve may be scaled in any manner appropriate to the logging equipment design, but it must be sensitive enough to readily indicate anomalies.

#### Noise Log

The noise log is also acceptable for the detection of fluid movement outside pipe. It should be recorded from TD to the surface, and also directly opposite areas of suspected fluid migration. Vertical spacing between noise log stations may vary with the individual well conditions and tool sensitivity, but should never be greater than 50 feet.

The tool response shall be filtered and recorded as a minimum of four frequency curves at or near 200, 500, 1000, and 2000 Hz. The actual frequencies recorded may be determined by the design of the logging equipment.

#### Other Logs

Other logs or log formats unique to a logging service company such as casing caliper inspections, cement evaluation surveys, oxygen activation logs, etc. can be recorded according

ADDENDUM II (CONT'D)

to the logging service company's standard format. However, the general guidelines outlined above would still apply.

Reports

A report of results of the MIT shall be submitted to the TWC UIC Unit within 30 days of the completion of testing, and shall contain, but not be limited to, the following information:

1. a complete chronology and description of all tests performed and procedures followed, including reasons for the necessity for any unusual testing procedures if applicable,
2. an APT time/pressure table, and a copy of the recorder chart if one was made,
3. if the APT was conducted at less than 1000 psi, the justification for doing so,
4. copies of all logs run,
5. interpretation and discussion of all testing and logging results, including the identity of personnel making the technical interpretations, and
6. certification by the individual preparing the report that all test data are true and correct, and that any non-standard test procedures followed received prior approval from the TWC UIC Unit.

John Hall, Chairman  
Pam Reed, Commissioner  
Peggy Garner, Commissioner



⑥ *Brian*  
*Pile*  
*minnie/wd file*

## TEXAS WATER COMMISSION

PROTECTING TEXANS' HEALTH AND SAFETY BY PREVENTING AND REDUCING POLLUTION

June 11, 1993

RECEIVED  
WATER  
SPLITTY DIVISION  
93 JUN 17 AM 8:05  
GW-S

Mr. I. O. Coleman, Jr.  
Environmental Affairs Section Leader  
Hoechst Celanese Chemical Group, Inc.  
Bay City Plant  
P. O. Box 509  
Bay City, Texas 77404-0509

Re: Approval of Request for Extension of Due Date for Mechanical Integrity Testing and Temperature Log Requirements, TWC Permit No. WDW-14 and Temperature Log Requirements Only, TWC permit No. WDW-110; Hoechst Celanese Chemical Group, Inc., Bay City Plant

Dear Mr. Coleman:

The letter dated May 20, 1993, from Ms. Kaymartha Williams of your staff requested an extension to February 25, 1994, of the December 1, 1993, and October 31, 1993, due dates in satisfying the Mechanical Integrity Testing (MIT) and Temperature Log requirements, respectively, for WDW-14. The letter further went on to request an extension to February 25, 1994, of the January 28, 1994, due date in satisfying the WDW-110 Temperature Log requirement. These requests are hereby approved pursuant to 31 TAC § 331.64.d.

Please note that since this is the second consecutive year an MIT extension has been approved for WDW-14 the MIT due date for the following year will be 12 months from the original due date above, or December 1, 1994.

Please plan to inform me of the exact date of the above WDW-14 MIT, as soon as the information becomes known, so that I may schedule to be present during testing. Please keep a copy of this letter with your disposal well records so that it will be available for review by Commission staff during inspections. If

*Direc*

John Hall, Chairman  
Pam Reed, Commissioner  
Peggy Garner, Commissioner

(6)

## TEXAS WATER COMMISSION

PROTECTING TEXANS' HEALTH AND SAFETY BY PREVENTING AND REDUCING POLLUTION

January 21, 1993

Mr. I. O. Coleman, Jr.  
Hoechst Celanese Chemical Group, Inc.  
Bay City Plant  
P. O. Box 509  
Bay City, Texas 77404-0509

Re: Approval of Modified Proposal to Recomplete Well Into Upper Miocene Injection Interval, TWC Permit No. WDW-110

Dear Mr. Coleman:

This letter is to document receipt of your proposal dated December 11, 1992, requesting approval to modify the original proposal for recompletion of the above referenced well into the upper Miocene injection interval (3,350 to 3,600 feet depth). Pursuant to 31 TAC § 331.63.g., approval to commence this recompletion is hereby granted. Please note that any subsequent divergence from these approved plans will require prior authorization by the Commission.

Pursuant to 31 TAC §§ 331.65.b.4. and 331.65.c.1., within 30 working days of completion of the workover and subsequent testing please submit a report to the executive director completely detailing all work performed and procedures followed.

It is requested that myself, or my absence, another member of the UIC Team be informed, as soon as the information is available, of the date of mechanical integrity testing so that someone may schedule to be present to witness these phases of the operation. If you have any questions, please do not hesitate to contact me at 512/908-6638.

sincerely,



Richard E. Merritt, Permit Coordinator  
Underground Injection Control Team  
Permits Section  
Industrial and Hazardous Waste Division  
Office of Waste Management and Pollution Cleanup

RM/

cc: Brian Graves, U.S.E.P.A. - Region VI (Mail Code 6WSU)  
T.W.C. District 7 Office - Houston

January 29, 1993  
KW-018-93

**Chemical Group**  
Hoechst Celanese Corporation  
Bay City Plant  
PO Box 509  
Highway 3057  
Bay City, TX 77404-0509

Mr. Mac Weaver, Chief  
Underground Injection Control Program  
Environmental Protection Agency  
1445 Ross Avenue Suite #1200  
Dallas, Texas 75202-2733

Re: Submittal of the 1991 and 1992 Injection Zone Annual Reports  
Hoechst Celanese Chemical Group, Inc.  
Bay City, Texas EPA ID No. TXD026040709

Dear Mr. Weaver:

Enclosed, please find a copy of the 1991 and 1992 Injection Zone Annual Reports for the Hoechst Celanese Chemical Group, Inc., Bay City Plant. The report was prepared by our contractor, DuPont Environmental Remediation Services.

If you have questions concerning the report, please contact me at (409) 241-4123 or Mr. I.O. Coleman, Jr. at (409) 241-4197.

Sincerely Yours,



Kaymartha Williams  
Environmental Engineer

Attachments

cc: w/o Attached Report

Mr. Hesus Garza  
Executive Director  
Texas Water Commission  
P.O. Box 13087, Capitol Station  
Austin, Texas 78711

Mr. Anne Dobbs, Chief  
Hazardous and Solid Waste Enforcement Section  
Hazardous and Solid Waste Division  
Texas Water Commission  
P.O. Box 13078, Capitol Station  
Austin, Texas 78711

Mr. Ben Knape, Head  
Underground Injection Control Section  
Texas Water Commission  
P.O. Box 13087, Capitol Station  
Austin, Texas 78711

Mr. Richard Merritt,  
Underground Injection Control  
Texas Water Commission  
P.O. Box 13087, Capitol Station  
Austin, Texas 78711-3087

John Hall, Chairman  
Pam Reed, Commissioner  
Peggy Garner, Commissioner



Wat 18-6-5-9



## TEXAS WATER COMMISSION

PROTECTING TEXANS' HEALTH AND SAFETY BY PREVENTING AND REDUCING POLLUTION

February 12, 1992

Mr. I. O. Coleman, Jr.  
Environmental Affairs Section Leader  
Hoechst Celanese Chemical Group, Inc.  
Bay City Plant  
P. O. Box 509  
Bay City, Texas 77404-0509

Re: Approval of Closure of Current Injection Interval, TWC  
Permit No. WDW-110

Dear Mr. Coleman:

Your letter of February 7, 1992, requested approval to initiate closure of the lower Miocene injection interval (approximate subsurface depth of 5,700 to 5,950 feet) as part of the previously approved temporary abandonment status - by letter dated January 14, 1992 - of the waste disposal well, WDW-110. This request has been reviewed and is hereby approved.

Please be advised that even though the injection tubing will be removed from the well the casing will be required to be filled with brine and a pressure of at least 100 psig maintained and recorded at all times. Please also be advised that although the terms of TWC Permit No. WDW-110 allow injection into the upper Miocene injection interval (approximate subsurface depth of 3,350 to 3,600 feet) injection of any hazardous constituents, subsequent to possible future completion into this interval, will not be allowed unless a modification of the No-Migration Petition pursuant to 40 CFR 148 is obtained.

Please keep a copy of this letter with your disposal well records so that it will be available for review by Commission staff during inspections. If you have any questions, please do not hesitate to contact me at 512/463-7917.

Sincerely,

A handwritten signature in black ink, appearing to read "Dick Merritt".

Richard E. Merritt, Permit Coordinator  
Underground Injection Control Unit  
Permits Section  
Industrial and Hazardous Waste Division

RM/

cc: Brian Graves, U.S.E.P.A. - Region VI (6WSU)  
T.W.C. District 7 Office - Houston

REC'D 18 MAR 3 1992  
SIS

*Ronnie*

Hoechst Celanese

(S)

October 22, 1990  
IOC-326-90

**Chemical Group**  
Bay City Plant  
Hoechst Celanese Corporation  
PO Box 509, FM 3057  
Bay City, TX 77404-0509  
409 245 4871

Mr. Minor Brooks Hibbs, Chief  
Permits Section  
Hazardous And Solid Waste Division  
Texas Water Commission  
P. O. Box 13087, Capitol Station  
1700 North Congress Ave.  
Austin, Texas 78711-3087

*AP*  
**RECEIVED**

OCT 30 1990

EPA 6W-S  
REGION VI

**Subject:** Waste Disposal Wells Minor Amendment Application  
Texas Water Commission (TWC) Draft Permits,  
Numbers, WDW-14, WDW-32, WDW-49 and WDW-110  
Hoechst Celanese Chemical Group, Inc.  
Bay City Plant, Bay City, Texas  
(References: Mr. Minor Brooks Hibbs' Letter Dated  
October 15, 1990 to Mr. I.O. Coleman, Jr. And Notice  
Of Consideration Of Amendment To Hoechst Celanese  
Chemical Group, Inc, Bay City, Texas Signed By  
Ms Brenda W. Foster, Chief Clerk, TWC Dated  
October 19, 1990, Enclosed As Addendum I And II)

Dear Mr. Hibbs:

As followup to the above reference documents, the Hoechst Celanese Chemical Group, Inc., Bay City Plant requests Texas Water Commission (TWC) to: (1) delay the permit amendment process associated with WDW-14, 32, 49 and 110 and (2) remove from the agenda the "Notice of Consideration of Amendment" for same in accordance with Section 26.028, Texas Water Code, and 31 TAC 305.62(c)(2) and TAC 305.96 (b), Rules of the Texas Water Commission, which is scheduled to come before TWC at its regular meeting on November 7, 1990.

The above request are made to allow us an opportunity to submit to the Environmental Protection Agency (EPA), Region VI, a request to revise our existing No-Migration Petition. As your Mr. Roth and Mr. Meritt are aware, we specifically will request that the density range associated with the injected fluids be increased.

Delaying the permit amendment process until EPA approves the new density range will remove the necessity of undergoing the amendment process and hearing twice in close secession.

Your consideration of our request is appreciated.

WAT 18-6-5-9

Hoechst E

Don't hesitate to contact by telephone Mr. R. D. Riley at (409) 245-4871, Ext. 4033 or me at Ext. 4197 if you have any questions pertaining to this matter.

Sincerely,

*I. O. Coleman, Jr./RAR*

I. O. Coleman, Jr.  
Environmental Affairs, Industrial Hygiene And Health Section Leader

IOC/la

cc: Mr. Thomas Roth, Chief  
Underground Injection Control Section  
Hazardous And Solid Work Division  
Texas Water Commission  
P. O. Box 13087, Capitol Station  
1700 North Congress Ave.  
Austin, Texas 78711-3087

Mr. Richard E. Merritt, Geologist  
Underground Injection Control Section  
Hazardous And Solid Waste Division  
Texas Water Commission  
P. O. Box 13087, Capitol Station  
1700 North Congress Ave.  
Austin, Texas 78711-3087

Ms. Brenda W. Foster, Chief Clerk  
Texas Water Commission  
P. O. Box 13087, Capitol Station  
1700 North Congress Ave.  
Austin, Texas 78711-3087

Mr. Ronald Crossland  
United States Environmental Protection Agency  
Region VI  
1445 Ross Avenue  
Dallas, Texas 75202-2733

Mr. Brian Graves  
United States Environmental Protection Agency  
Region VI  
1445 Ross Avenue  
Dallas, Texas 75202-2733

*Crossland*

(S)

## TEXAS WATER COMMISSION

B. J. Wynne, III, Chairman  
John E. Birdwell, Commissioner  
Cliff Johnson, Commissioner



John J. Vay, General Counsel  
Michael E. Field, Chief Hearings Examiner  
Brenda W. Foster, Chief Clerk

Allen Beinke, Executive Director

November 3, 1989

**RECEIVED**

NOV 06 1989

EPA 6W-S

REGION VI

Mr. I.O. Coleman  
Hoechst Celanese  
Post Office Box 509  
Bay City, Texas 77414

Re: Completion of Petition Review and Issue of Summary Report  
EPA Facility ID No. TXD026040709

Dear Mr. Coleman:

This is to inform you that the Commission's staff has completed the review of the referenced petition. A summary report has been completed and sent to Ronnie Crossland, EPA, Region VI, Dallas, Texas. Any further correspondence on this petition should be addressed to Ronnie Crossland at EPA's regional office. Please forward copies of all EPA correspondence to the Texas Water Commission's UIC unit so that we may be kept up to date.

If you have any questions please call Tom Roth at 512/463-8282.

Sincerely,

A handwritten signature in black ink, appearing to read "Russell S. Kimble".

Russell S. Kimble, Chief  
Hazardous and Solid Waste Enforcement Section  
Hazardous and Solid Waste Division

TR:ok

cc: Ronnie Crossland, EPA, Region VI, 1445 Ross Avenue,  
Dallas, Texas 75202

WAT 18-6-5-9

(5) mAP

## TEXAS WATER COMMISSION

B. J. Wynne, III, Chairman  
John E. Birdwell, Commissioner  
Cliff Johnson, Commissioner



John J. Vay, General Counsel  
Michael E. Field, Chief Hearings Examiner  
Brenda W. Foster, Chief Clerk

Allen Beinke, Executive Director

November 2, 1989

Oscar Cabra, Jr., P.E.  
Chief, Water Supply Branch  
U. S. Environmental Protection Agency  
Region VI  
1445 Ross Avenue  
Dallas, Texas 75202

Re: 40 CFR 148 Land Ban "No-migration" Petition Summary  
Hoechst Celanese Chemical Group, Inc. - Bay City

Dear Mr. Cabra:

Enclosed is the HSWA petition review and summary report prepared by the Underground Injection Control Unit of my staff for the above cited facility. The report is a result of an extensive staff review of the land ban petition submitted by the facility pursuant to 40 CFR Part 148 Subpart C.

The staff has determined that the petition is in compliance with the petition standards and procedures of Subpart C. If you have any questions please contact Mr. Thomas P. Roth of my staff at 512/463-8425.

Sincerely,

Russell S. Kimble, Chief  
Hazardous and Solid Waste Enforcement Section  
Hazardous and Solid Waste Division

DR/da

Enclosure

RECEIVED

NOV 09 1989

EPA GWS  
REGION VI

WAT 18-6-5-9 Section 2

11-2-89

HWSA PETITION REVIEW AND SUMMARY  
FOR THE INJECTION OF RESTRICTED HAZARDOUS WASTE

ADMINISTRATIVE INFORMATION

FACILITY NAME: Hoechst Celanese Chemical Group, Inc.  
Bay City Plant  
ADDRESS: Farm Road 3057 P.O. Box 509  
CITY: Bay City  
STATE: Texas  
ZIP CODE: 77414  
CONTACT: I.O. Coleman, Jr.  
PHONE NUMBERS: (409) 245-4871 Ext 4197  
WELL NUMBERS: 2, 3, 4, 1-A and proposed Well 5  
UIC PERMIT NUMBER: WDW-14, 32, 49, 110 and proposed WDW-277  
RCRA ID NUMBER: TXD 026040709  
LEGAL LOCATION: See Below

(Petition volume/page number references in parentheses)

WDW-14

The well is located 5,230 feet south and 2,220 feet west of the most northerly northwest corner of the company property which is located on the James Moore League, Abstract No. 62, Matagorda County, Texas. (1-15)

WDW-32

Located 4,292 feet south and 2,029 feet west of the most northerly 1-20 northwest corner of company property which is located on the James Moore League, Abstract No. 62, Matagorda County, Texas. (1-20)

WDW-49

The well is located 3,489 feet north and 2,442 feet east of the southwest corner of company property which is located on the James Moore League Abstract No. 62, Matagorda County, Texas. (1-23)

WDW-110

Located on company property 18,050 feet from the east line and 2,200 feet from the north line of the James Moore League, Abstract No. 62, Matagorda County, Texas. (1-26)

WAT 18-6-5-9 Section Z

WDW-277

Not yet drilled; permit application submitted to TWC in 1988

The well will be located approximately 400 feet north, northeast of WDW-110. Approximate coordinates for the proposed well site are 17,225 feet from the east line and 2,000 feet from the north line of the James Moore League, Abstract No. 62, Matagorda County, Texas. (1-30)

A preliminary review of the submitted petition on the above wells has been performed. This petition was done in accordance with 40 CFR 148.20, to demonstrate to a reasonable degree of certainty that:

- (i) Fluid movement conditions are such that the injected fluids will not migrate within 10,000 years:
  - (a) vertically upward out of the injection zone; or,
  - (b) laterally within the injection zone to a point of discharge or interface with a USDW.

WASTE PROPOSED TO BE EXEMPTED FROM LAND BAN RESTRICTIONS

The petition has been submitted in order to allow the injection of the following hazardous waste(s):

There are two waste streams injected by the Bay City Plant. The first stream is known as "acid" waste, and the other stream is known as "neutral" waste. (1-5)

ACID WASTE STREAM

The "acid" waste stream is generated from the manufacture of acetaldehyde, n-butyl alcohol, n-propyl alcohol, isobutyl alcohol and vinyl acetate. The "acid" waste stream is composed principally of water containing small amounts of halogenated organic compounds (HOC's), ash and trace quantities of metals. The HOC's derive from distillation side cuts (K010) and distillation bottoms (K009) from the production of acetaldehyde from ethylene. The "acid" waste stream is hazardous as a result of the K009 and K010 components. Ammonia (NH<sub>3</sub>) or sodium hydroxide (NaOH) is used to adjust the pH of the waste prior to injection. The typical pH of the injected "acid" waste stream is about 2.2, with a range of 2 to 3 (the pH is always controlled to be greater than 2.0). (1-6)

NEUTRAL WASTE STREAM

The "neutral" waste stream is primarily contaminated rainwater and washwater generated from the manufacture of acetaldehyde, vinyl acetate, n-buytl alcohol, n-propyl alcohol, iso-buytl

alcohol, heptanoic acid, nonanoic acid, hydrogen, synthesis gas, heptanal and nonanal.

Normally, the waste stream consists principally of water containing small amounts of ash, oil and grease, and trace quantities of metals. In addition, contaminated rainwater runoff, and washwaters can at times be added to the waste stream and injected as part of the "neutral" waste. Ammonia (NH<sub>3</sub>) or sodium hydroxide (NaOH) is added to the waste stream to adjust the pH prior to injection, with the typical pH of the injected waste stream being about 6.2 with a range between 6.0 and 6.5.

Although the "neutral" waste is non-hazardous, the "neutral" well system is being petitioned to allow injection of the "acid" waste waste stream, during shutdown of WDW-110. In an abundance of precaution, it is assumed that this waste stream, at the time of injection into the "neutral" well system, is impacted by the "acid" waste ban date. (1-7)

WELLBORE SCHEMATICS (attached Figures)

WELL HISTORY (see attached Appendix 1)

AREA OF REVIEW EVALUATION:

1. Discuss procedure used for identifying all artificial penetrations.

Several data sources were utilized to locate pertinent information regarding each artificial penetration. Revised or updated base maps from Tobin Surveys, Inc., Cambe Geological Services, Inc., the Matagorda County oil and gas base map maintained by the Railroad Commission of Texas (RRC) and the RRC Buckeye Field Map Number 567 were utilized to initially identify and establish a general background on the wells in the Area of Review. State agency files along with state libraries were researched by Agency Information Consultants, Incorporated (AIC) for descriptive well documentation. The regional libraries of Cambe Geological Services, Inc., a commercial log service company, were researched for well logs and scout tickets applicable to each well identified in the Area of Review. Additional records data were obtained through the University of Texas, Balcones Research Center. Where discrepancies existed among data sources, data contained in state forms were considered to be most accurate. (4-88)

2. How many wells within the AOR penetrated the confining zone?

In the record search submitted by the petitioner, thirty-one artificial penetrations were identified in the Area of Review.

There are no currently active wells in the 2.5 mile Area of Review and all thirty-one wells have been plugged and abandoned. (4-21)

3. What method was used to determine that each well, which penetrated the confining zone within the AOR, was constructed or plugged adequately to prevent the migration of waste from the injection zone?

Each artificial penetration (active/abandoned) was evaluated as to the adequacy of construction and plugging to determine the potential of the penetration to convey fluid from an injection zone into the overlying USDWs (non-endangerment) and the potential of the penetration to convey the injected waste out of the injection zone (no migration). Potential problem wells were identified and were subsequently evaluated or modeled to determine the need for corrective action. (4-88)

#### Proper Plugging

For purposes of the Artificial Penetration Review Protocol, the "Statewide Rules For Oil, Gas and Geothermal Operations", from the State of Texas was used to determine proper plugging requirements for the protocol, as the rules are very specific and stringent. The Railroad Commission of Texas, under Statewide Rule 14, (1967), demands all formations bearing USDWs, and oil, gas, or geothermal resources be protected with type-specific cement plugs and mud-laden fluid. Uncemented areas in the abandoned wellbore must be filled with a mud-laden fluid weighing at least 9.5 lb/gal. Setting depths for cement plugs are dependent upon the construction of the well and the geological environment. Wells abandoned with only surface casing should be plugged across the base of the lowermost USDW regardless of casing depth. When insufficient surface casing is set to protect all USDWs and such strata are exposed to the open wellbore, a cement plug must be placed across the exposed strata with an additional cement plug set across the surface casing shoe. When sufficient surface casing has been set to protect all USDWs, a cement plug must be set across the surface casing shoe.

For wells abandoned with protection and/or production casing that have been cemented through all USDW bearing strata, all productive horizons must have cement plugs placed inside the casing and centered opposite the base of the lowermost USDW. For wells abandoned with protection and/or production casing set back to surface, the casing must be perforated at the depths required to protect all productive horizons and the lowermost USDW with cement placed outside of the casing by squeeze cementing. Wells determined to be improperly plugged by the above criteria were labeled as "potential problem wells" and were evaluated or modeled for potential upward movement of fluids. (4-88)

#### Proper Well Construction

For the purpose of this protocol, a properly constructed active well is defined as a well in which the annulus between the borehole and a casing string has been effectively sealed by cement across and/or above the correlated injection interval(s) thereby preventing vertical fluid movement. Wells that were drilled into or through the injection interval and abandoned with protection and/or production casing left in the hole pose potential problems. If cement was not circulated to a depth above the correlated injection interval, only drilling fluid would be present in the annulus. Although the drilling fluid in the annulus would provide the same resistance to vertical fluid movement as a mud plug in the wellbore, active wells that were constructed improperly were also listed as potential problem wells and evaluated or modeled for possible vertical fluid movement.

Cement volume calculations were made on each well that has full protection and/or production casing left intact in the well. Only conservative data values were used in the calculations. One inch was added to the borehole diameter and all slurry volumes were calculated using Class H cement (1.06 ft<sup>3</sup>/sack-slurry volume).

4. Were adequate construction and plugging records submitted for all wells that penetrated the confining zone? If not, discuss all deficiencies.

Incomplete Records

A search of all records available did not produce completion and plugging reports for United North & South Development Co. L. V. Stoddard No. 8. AIC did locate a permit dated February 3, 1943. All base maps available were examined including those contained in the hearing files: Adobe Oil and Gas Corporation, Buckeye South Field, file No. F-10-B, June 6, 1983, F. B. Lacy, Inc., Buckeye West Field, file No. 913, and the United North and South Development Company, Buckeye Field Discovery File No. 4310. The Adobe Oil and Gas Field map failed to show the well in question, but the remaining hearing file maps did include the L. V. Stoddard No. 8 well. AIC also examined previous permits for the Bay City Plant on file with the Texas Water Commission (TWC) which were dated July 22, 1971. These documents stated that the well in question was never drilled. Cambe and the Balcones Research Center had no records of a No. 8 well drilled by United North & South Development Company. It was noted in the research of the RRC files, the driller's logs at the Balcones Research Center and the scout tickets of Cambe, that records were available for the wells numbered below and above the well on this lease. Based on this fact, it can be reasonably concluded that this well was probably never drilled. Adequate records were submitted for all other known artificial penetrations within the area of review. (4-20 & 4-21)

5. Were all wells with sufficient information adequately constructed or plugged to prevent the migration of waste from the injection zone?

Twelve artificial penetrations within the 2.5-mile Area of Review are improperly plugged pursuant to the non-endangerment criteria outlined in the Artificial Penetration Protocol (Appendix 4-1) as there are no cement plugs between the injection intervals and the USDW. All twelve non-endangerment potential problem wells (see Appendix 4-3) were modeled to determine if they presented a potential threat to a USDW due to injection operations (Section 4.5). Nineteen artificial penetrations within the 10,000 year plume paths are improperly plugged pursuant to the no migration criteria as there are no cement plugs above the injection intervals within the injection zone (six of these wells were modeled as non-endangerment potential problem wells). Maps in Appendix 4-3 show the artificial penetrations within the plume paths for the upper Miocene and lower Miocene injection intervals at year end 2000 and in 10,000 years. Artificial Penetration No. 10 (where pressures are greater than at any other no migration potential problem well) was conservatively chosen to be modeled, thereby presenting a worst-case modeling scenario. (4-24 & 4-25)

6. Were all deficiencies identified in steps 4 and 5 properly addressed with a corrective action plan?

The modeling results detailed in the petition show that Artificial Penetration 10 is safe as currently abandoned because the pressure buildup at the artificial penetration over time is much less than that necessary to displace the static mud column in the borehole. Since the increased formation pressure rapidly declines once injection has ceased, Artificial Penetration No. 10 will not serve as a conduit for waste movement at any time in the future. The petitioner considered the other eighteen no migration potential problem wells to be safe now, as well as in the future, since they are subjected to much lower pressures than Artificial Penetration No. 10 due to their greater distance from the injection wells. (4-3)

The petition states that based on the results of the artificial penetration modeling study, no corrective action is necessary for any of the potential problem wells in the Area of Review of Hoechst Celanese Bay City Plant, Injection Wells WDW-110, WDW-14, WDW-32, WDW-49 and proposed WDW-277, pursuant to 40 CFR 146.64(C).

7. Summarize the proposed corrective action strategy for all deficiencies.

Within the scope of this review, no corrective action is required based on computer modeling of the potential problem wells. (4-3)

REGIONAL GEOLOGY (pages 3-2 to 3-15)

1. Summary of stratigraphic and structural features.

The following descriptions and characterizations of the regional geology are interpretations based on the available data (primarily well logs and core studies), (1) obtained from established service companies, state and federal geologic surveys, regulatory agencies, and professional geologic societies, and (2) presented in the Celanese-Bay City petition. The Bay City Plant is located in central Matagorda County, on the Texas Gulf Coastal Plain approximately 10 miles southwest of Bay City, Texas. There are approximately 40,000 feet of sediments underlying the plant site ranging in age from Triassic to Holocene (page 3-2). The stratigraphic section for the Bay City area is shown on the attached copy of Figure 3-1 (page 3-4). Wastes are currently being injected into Miocene age sands (Tertiary Period), which are confined by shales which are also of Miocene age.

During the Tertiary Period, sediments were deposited along the margin of the Gulf Coast basin, an extracratonic basin characterized by rapid subsidence in areas of sediment loading. Three major structural provinces have been defined along the Texas Gulf Coast; these provinces are, from north to south, the Houston Embayment, the San Marcos Platform (or Arch) and the Rio Grande Embayment (Galloway, et al, 1982). The Bay City Plant is located in the northeastern portion of the broadly defined San Marcos Platform adjacent to the Houston Embayment (see attached Figure 3-2) (Bebout, et al, 1978). The Houston Embayment is characterized by salt diapirism with its associated faulting and large salt withdrawal sub-basins (Bishop, 1978). In contrast, the San Marcos Platform is characterized by linear belts of growth faults and associated shale ridges and diapirs, with the underlying salt being thin or absent. As the Oligocene-Holocene section thickens basinward, major fault and diapiric displacement sometimes extends upward through the unit, and deformation becomes increasingly complex. In contrast, the updip portions of progradational wedges are relatively undisturbed by faulting and diapirism.

2. Historical seismic activity in the region. (petition pages 3-3 to 3-9)

The Texas Gulf Coast is historically an area of low seismicity with naturally occurring earthquakes being rare and of low magnitude. This is demonstrated by the seismic risk map of the United States (see attached Figure 3-3, after Algermissen, 1969) and a map of earthquake locations and magnitudes in Texas (see attached Figure 3-4, modified from Davis, et al, 1985)).

Based on historical data, the likelihood of an earthquake is considered extremely remote at the Bay City Plant. All of the earthquakes recorded within 150 miles of the plant have been of a

magnitude 4.4 or less, which the petition indicates, would cause no noticeable damage to man-made structures. Therefore, the probability of an earthquake with the magnitude to damage the injection well systems appears very low.

Although earthquakes induced by fluid injection and fluid withdrawal from oilfield operations have been documented along the Texas Gulf Coast, these events were associated with much higher injection pressure and or injection/withdrawal volumes than encountered in the Bay City area from Celanese injection wells or oil production wells in the area (page 3-8). No earthquakes have been known or postulated to have resulted from relatively low volume, low pressure injection operations such as those at the Celanese Bay City plant (Davis, et al, 1987).

### 3. Information submitted on the regional geology.

The Texas Gulf Coast has been subjected to intensive geologic investigation and exploration for oil and gas, and mineral deposits since the early part of this century. Accordingly, the sources of geologic information for the petition include well logs from exploratory drilling and oil and gas production, and numerous publications of the Texas Bureau of Economic Geology (TBEG), and the American Association of Petroleum Geologists (AAPG). Data on the historical seismic activity were summarized from Gulf Coast Assoc. Geol. Soc., 1985. Other sources of geologic information include reports and files of the Texas Water Commission (and its predecessors), and the Texas Railroad Commission.

Regional geology is presented in Section 3.2 of the petition. Within this section are included discussions of stratigraphy, structure, and seismicity.

Important figures are as follows:

- Figure 3-1 (page 3-4) - Stratigraphic Column for the Bay City Plant
- Figure 3-2 (page 3-5) - Structure Contour Map on the Top of the Frio Formation
- Figure 3-3 (page 3-6) - Seismic Risk Map of the United States
- Figure 3-4 (page 3-7) - Earthquake Epicenters and Magnitudes in the State of Texas
- Appendix 3-1 (page 3-39) - Project Reference Map
- Appendix 3-2 (page 3-40) - Cross Section A-A' (West - East)

Appendix 3-3 (page 3-41) - Cross Section B-B' (North - South)

Appendix 3-4 (page 3-42) - Type Logs

Appendix 3-20 (page 3-58) - Regional Structure Maps: Approximate Top of Confining Zone

4. Does the petition contain adequate information to accurately describe the regional geology?

The petition's characterization of regional geology appears to be consistent with and to be based on extensive geologic reports from sources listed above in summary report item number 3. Collectively, these sources reflect the HSWA, 1984 standard of being "best available" sources of geologic information, which are commonly used and relied on by experts in the field for mineral resource exploration, injection well permit applications, and other environmental engineering projects. The study of regional geology is generally acknowledged by experts to provide a background for detailed study of local geology, and for this reason, regional geology should be considered an appropriate part of the Celanese-Bay City petition. As such, the petition's presentation of regional geology appears to be consistent with 40 CFR 148.20 and 40 CFR 148.21, which specify the necessary requirements for successful petition demonstrations.

LOCAL GEOLOGY

1. Summary of stratigraphic and structural features.  
(petition pages 3-16 to 3-20, and 2-9 and 2-10)

The following descriptions and characterizations of the local geology are interpretations based on the available data (primarily well logs and core studies), which are both (1) obtained from established service companies, state and federal geologic surveys, regulatory agencies, and professional geologic societies, and (2) presented in the Celanese-Bay City petition. The local stratigraphic section is depicted schematically in the attached copy of petition Figure 3-1 (page 3-4). The following summary of stratigraphy at the Celanese Bay City site is presented from the deepest (oldest) strata upward to the land surface.

The Anahuac Shale directly underlies the injection zone. This unit of calcareous shale with localized limestone units is found on well logs throughout the Texas Gulf Coast, and should be a good barrier against downward movement of fluids from the Celanese injection zone.

The Miocene section (Fleming Group) overlies the Anahuac, and contains the Celanese injection and confining zones. Although delineated in some locales into a lower formation (Oakville) and an upper formation (Lagarto), the entire Miocene is undifferentiated at the Bay City plant (page 3-17). The lower Miocene is characterized by prominent strike-oriented sandstone

belts representing barrier-strandplain depositional systems which are bounded up and down dip by finer-grained sediments (page 3-12). The upper Miocene is characterized by massive shales with thin to medium bedded sandstones, representative of cycles of sediment progradation alternating with periods of shoreline stability. (pages 3-12 and 3-14)

Conformably overlying the Miocene section are the Pliocene age sediments of the Goliad Formation, composed of interbedded fluvial and deltaic sandstones with occasional minor conglomerates (page 3-14). The Goliad Formation is roughly equivalent to the Evangeline aquifer. (page 3-14)

Conformably overlying the Pliocene age sediments of the Willis, Lissie, and Beaumont Formations which were deposited under the influence of complex glacial and interglacial sea level cycles. The Willis Formation is characterized as a fluvial and deltaic unit; the Lissie and Beaumont are predominantly fluvial. (pages 3-14 and 3-15)

The Pleistocene sediments grade conformably into the overlying Holocene depositional units (page 3-15). The combined Pleistocene and Holocene units constitute the Chicot (or Gulf Coast) aquifer. The undifferentiated Holocene section at the Bay City plant is characterized by fluvial sands and muddy floodplain deposits. (page 3-15)

Based upon the foregoing generalized summary of the localized stratigraphic section at the Celanese site, the geology of the injection and confining zones is summarized as follows. The undifferentiated Miocene section at the Celanese site, contains the injection and confining zones for the waste disposal well operation. Within the injection zone, there are two injection intervals, designated as the upper and lower Miocene injection intervals. These two injection intervals, the petition indicates, are separated within the injection zone by approximately 2,000 feet of shale section with interbedded sands (Figure 3-1). WDW-14, 32, and 49 are injecting wastes into the upper Miocene injection interval, and WDW-110 is injecting wastes into the lower Miocene injection interval. When proposed waste disposal well number 5 is drilled and completed, it will also inject waste into the lower Miocene injection interval.

The lower Miocene injection interval is laterally continuous within the AOR, with a net permeable sand thickness from 150 to 250 feet (Appendix 3-9). The lateral continuity of this sand interval is also exhibited in strike and dip cross sections, Appendices 3-2 and 3-3. On this basis, an average value of 203 feet was selected as the average thickness of this unit for modeling in Section 2 of the petition (Table 2-1). The sand in this interval begins to pinch out to the north and northwest of the AOR. (page 3-18)

The thick shale layer overlying the lower Miocene injection interval is composed of shale and thin sands. Within the AOR, the thickness of this shale interval ranges from approximately 150 to 250 feet (Appendix 3-10). Also, it is interpreted to be laterally continuous as shown in the strike and dip cross sections (Appendices 3-2 and 3-3). The layer is approximately 75% shale with generally non-continuous sand strata intermixed (Appendix 2-7).

The upper Miocene injection interval is interpreted to be laterally continuous over the AOR, with a net permeable sand thickness ranging from less than 50 feet, northwest of the plant site, to over 250 feet east of the plant (Appendix 3-11). The strike and dip cross sections display the lateral variation in sand thickness in this interval around the Celanese plant. Based on this data, an average value of 165 feet was selected as the average thickness of the upper injection interval for use in the modeling in Section 2 of the petition. (Table 2-1)

Immediately above the top of the upper Miocene injection interval is a shale layer approximately 50 to 75 feet thick, which is part of the permitted injection zone (Appendix 2-7). According to the petition's modeling, this shale layer is the unit into which the upward waste movement at the site will occur (due to various transport processes), and in which the waste will be contained for 10,000 years (page 3-20). Since this predominantly shale unit is based on regulatory terminology, and is not specifically defined as a stratigraphic unit based on time markers, it has not been mapped as a specific unit in the petition.

The confining zone is located immediately above the top of the permitted injection zone, and is predominantly shale with minor discontinuous sand lenses (page 3-20). The thickness of the confining zone ranges from approximately 375 feet to 450 feet within the AOR (Appendix 3-12). The lateral continuity of the confining zone is exhibited in the strike and dip cross sections (Appendices 3-2 and 3-2). The confining zone is approximately 90% shale with continuous and discontinuous sand units interspersed. This zone is the principal confining zone for the Celanese Bay City site, since all waste injection takes place below this zone, and according to the petition's modeling, all upward waste movement at the site will be contained in the permitted injection zone below this confining zone.

The Bay City Plant is located in the broadly defined San Marcos Platform bordering the Houston Embayment. The major structural style in the San Marcos Platform is linear belts of growth faults associated with shale ridges and diapirs, while the Houston Embayment is characterized by salt diapirism and associated faulting and deformation (page 3-16). The region surrounding the plant exhibits features from both structural provinces. Linear belts of growth faults dominate the structural style at the Frio structural level (see Figure 3-2), with

The only fault effecting the Miocene section in the AOR is a small, discontinuous fault located northwest of the plant site on the AOR boundary. The displacement on this fault is less than 50 feet, and only the lower portion of the Miocene section is affected as shown on Appendices 3-5 and 3-6, and Figure 3-5a. The presence of this fault is judged in the petition, to be inconsequential with regard to flow and containment of injected waste, because the waste plume will only reach the location of this fault near the end of the 10,000-year time frame, and in a worst case, the waste could only move up the fault plane to the point at which the fault dies out (below a subsurface depth of 5,000 feet). Therefore, in a worst case, the waste would still be confined nearly 2,000 feet below the top of the permitted injection interval. (pages 3-16, 3-16a, and 3-16b)

Further, undiscovered faults and fractures should not affect the integrity of Gulf Coast confining layers when operating pressures are maintained within permitted limits. As described in petition pages 2-9 and 2-10, Gulf Coast shales are known to exhibit viscoelastic deformational behavior (Aumann, 1966), (Neuzil, 1986), which causes any natural fractures present to close very rapidly under the action of the in-situ compressive stresses (Bowden and Curran, 1984), (Collins, 1986). Evidence of this rapid fracture closure is often encountered while drilling and running casing (Johnston and Knappe, 1986), and (Clark, Howard, and Sparks, 1987). Further, old abandoned boreholes have been observed to heal across shale sections to the extent that reentering them requires drilling a new hole (Clark, Howard, and Sparks, 1987). Petition Appendix 2-5, titled "Effect of Gulf Coast Faults on Containment of Injected Liquid Wastes", identifies the conditions governing potential fluid migration along faults. Based on these references from the literature, the vast majority of Gulf Coast faults are very unlikely to be vertically transmissive over large distances at the depths of concern to underground injection processes.

In addition to the growth faults, there is some salt diapirism in the area, with the closest salt dome (Markham Dome) being approximately 10 miles north of the Bay City Plant (page 3-16). At this distance, Markham Dome should exert no adverse influence on the injection zone as a contained waste disposal reservoir.

Within the AOR, the major structural feature is a low relief, structural nose plunging to the east (see Appendices 3-1 to 3-16). The structural nose is present at all structural levels from the Anahuac through the injection and confining zones (Miocene section). The genesis of this structural feature is interpreted to be related to a post-depositional deep seated salt

Zones

Depths  
(Subsurface in feet)\*      Formation(s)

Base of lowermost USDW	1,300	(Chicot Aquifer)
Confining zone	2,900 to 3,300	Miocene
Injection zone	3,300 to 5,950	Miocene Upper
Injection interval	3,350 to 3,600	Miocene Lower
Injection interval	5,700 to 5,950	Miocene

\* Depths are approximate measured log depths, as shown on Figure 3-1 (page 3-4), and taken from Type Log (map ID #9) in Appendix 3-4 (page 3-42).

3. Information submitted on the local geology

The petition's coverage of local geology is based largely on maps and cross sections constructed by E. I. duPont de Nemours Environmental Management Services, from well logs including the four Celanese injection wells, and from literature published by the Texas Bureau of Economic Geology (TBEG), the Texas Railroad Commission, the Texas Water Commission (or its predecessors), the American Association of Petroleum Geologists, and from Core Labs and other consulting and service companies.

Local geology is presented in Section 3.3 of the petition. Within this section are discussions of injection and confining zone stratigraphy and structure.

Important figures and tables are as follows:

- Figure 3-5a - Cross Section of Small Lower Miocene Fault
- Appendix 2-7 - Type Log
- Appendix 2-13 - Plume Extent in Upper Miocene Injection Sand
- Appendix 2-14 - Plume Extent in Lower Miocene Injection Sand
- Appendix 2-15 - Modeled Layers Stratigraphic Cross Section A-A'
- Appendix 2-16 - Modeled Layers Stratigraphic Cross Section B-B'
- Appendix 3-4 - Four Type Logs
- Appendix 3-5 - Structure Map: Top of Lower Miocene Injection Interval
- Appendix 3-6 - Structure Map: Top of Lower Miocene Shale Layer
- Appendix 3-7 - Structure Map: Top of Upper Miocene Injection Interval
- Appendix 3-8 - Structure Map: Top of Upper Miocene Confining Zone
- Appendix 3-9 - Net Sand Isopach: Lower Miocene Injection Interval
- Appendix 3-10 - Gross Interval Isopach: Lower Miocene Shale Layer
- Appendix 3-11 - Net Sand Isopach: Upper Miocene Injection

Appendix 3-14 - Gross Interval Isopach: Base of USDW to Top  
of Upper Miocene Confining Zone

Appendix 3-15 - Net Shale Isopach: Upper Miocene Confining  
Zone

Appendix 3-16 - Gross Interval Isopach: Permitted Injection  
Zone (WDW-110)

4. Verification of geologic information in the petition  
(petition page 7-12)

References listed on petition pages 3-34 to 3-36 were checked and determined to be predominantly from the Texas Bureau of Economic Geology, the American Association of Petroleum Geologists, the Texas Water Commission (or its predecessors), and core study reports by a variety of service companies. Oil and gas well records and records of exploratory drilling were obtained chiefly from the files of the Texas Railroad Commission. These literature sources are commonly used by experts in the field as the geologic basis for siting and development of injection well projects in Texas. Maps and cross sections prepared by the E. I. duPont de Nemours Environmental Management Services team, were verified from well logs submitted as Appendix 4-15 of the petition.

Verification of porosity and permeability data, and other parameters used in modeling are discussed in the Hydrology section of this summary report. It therefore appears that the petition comprises the best available analysis of geologic conditions in the area of the Celanese-Bay City injection wells. (40 CFR 148.20 and 40 CFR 148.21)

5. Comparison of geologic data with data used in the model  
(petition pages 2-81b)

This section of the summary report addresses the relation of geologic layer thickness to the actual model input. Other parameters used in modeling are detailed in the Hydrology section of this report. (page 2-81b)

The Celanese-Bay City petition model uses a 16-layer system, as detailed in Table 2-1 and Appendix 3-4. Layer thickness determination was based primarily on geophysical logs of the Celanese injection wells, plus logs of two additional oil and gas test wells.

In order to demonstrate the relationship between model layers and the geologic strata in the vicinity of the Bay City Plant, two stratigraphic cross sections were constructed. The cross sections are located in Appendix 2-15 (north-south) and Appendix

The cross sections and the type logs in Appendix 3-4. In making comparisons between geologic strata and modeling layers, the petition states that the model layers are idealized units alternating between either all shale or all sand. In general, the log-indicated net thickness of noncharacteristic sediments in a layer, i.e., sand or shale, was added to the underlying layer to obtain layer thicknesses for model input. However, layers labeled as overlying confining shales and injection sands, were kept intact (no additional shale or sand was added from adjacent layers). The thickness of each model layer is represented to be an average thickness over the areal extent of the layer; these model layer thicknesses are based primarily on the geology close to the injection wells but are adjusted to reflect the geology within the AOR. (page 2-81b)

The thickness of the injection sands and confining shales, and their lateral extent, are key questions in the petition review (40 CFR 148.21). The cross sections demonstrate the continuity of the injection sands and overlying confining shales within the area. The thicknesses of the injection sands vary across the area, but the model injection sand layers depict an average thickness over the AOR. Considering the idealized nature of the model layers, they correspond reasonably to the actual strata at the site. (40 CFR 148.21)

6. Conservative estimation of all non-site specific parameters  
(petition pages 2-15 to 2-25d)

There is no recorded site-specific information for the following parameters: 1) shale layer (confining layer) porosities 2) shale layer permeabilities, 3) fluid viscosity in shale layers, and 4) rock compressibility for all layers (sand and shale). The values for rock compressibility, shale porosity, and shale permeability were conservatively estimated from published and unpublished studies (see Tables 2-3a and 2-3b, pages 2-25c and 2-25d, and 40 CFR 148.21). The fluid viscosity in the shale layers is estimated from the viscosity value from the closest sand layer. (Refer to the Hydrology section of this summary report.)

7. Does the petition contain adequate information to accurately describe the local geology?

The petition's characterization of the local geology appears to be consistent with and to be based on extensive geologic reports by established oil field service companies, state and federal geologic surveys (Texas Bureau of Economic Geology and the U. S. Geologic Survey), regulatory agencies (the Texas Water commission and the Texas Railroad Commission), and various professional geologic societies. Collectively, these sources reflect the HSWA, 1984 standard of being "best available" sources

projects. Using these sources, the petition's coverage of the local geology appears to itself comprise the best available report on the local geology of the Celanese plant area, in the context of injection well operations. As such, the petition's section on local geology appears to be consistent with 40 CFR 148.20 and 40 CFR 148.21, which specify the necessary requirements for successful petition demonstrations.

## HYDROGEOLOGY

### 1. Hydrogeology of the injection and confining zones.

Lower Miocene Injection Interval/Confining zone (pages 3-17 and 3-18)

The lower Miocene injection sand interval was deposited in a shoreline or beach-barrier island depositional environment and is interpreted to be in the Oakville or lower half of the undifferentiated Miocene section at the site (page 3-17). Within the Area of Review (defined by a 2.5 mile radius circle around the injection wells), the injection sand is laterally continuous with a net permeable sand thickness ranging from approximately 150 feet to 250 feet (see Appendix 3-9). The lateral continuity of the sand is also exhibited in the strike and dip cross sections (see Appendices 3-2 and 3-3). On this basis an average value of 203 feet was selected as the average thickness of this unit for the modeling in Section 2 of this petition (page 3-18). It should be noted that the sand does begin to pinchout to the north and northwest of the Area of Review.

Porosity and permeability values for this unit were obtained from core samples taken in WDW-110 (Core Labs, Inc., 1973, included in petition as Appendix 2-9). The average porosity of the injection sand is 32.2% and the average permeability to air is 1606 millidarcies (page 3-18). A porosity and permeability of 32% and 1300 millidarcies were selected as the average values of this unit for the modeling in Section 2 of this petition (the downward adjustment of permeability is described in Section 2). Copy of the original core report is contained in Section 2 of the petition (see Appendix 2-9). Based on core lithology descriptions, the injection sand is fine to medium grained with minor calcareous intervals. Based on x-ray diffraction of two core samples from this sand it has: 1) a quartz content ranging from 65% to 71%, 2) feldspar content ranging from 5% to 9%, 3) mixed layer clay content from 16% to 30%, and 4) a calcite and kaolinite content averaging 0.5% and 1.5% respectively (Halliburton Chemical Laboratory, 1973).

A chemical analysis of the lower Miocene formation fluid has been performed and the data is included in Section 6 of this

of the Oakville or lower half of the undifferentiated Miocene section at the site. Within the AOR, the thickness of this shale layer ranges from approximately 150 feet to 250 feet (see Appendix 3-10). Also, it is laterally continuous as shown in the strike and dip cross section (see Appendices 3-2 and 3-3). The layer is approximately 75% shale with generally non-continuous sand units intermixed. (page 3-18)

Upper Miocene Injection Interval/Confining Zone (pages 3-19 and 3-20)

The depositional environment of the upper Miocene injection interval is interpreted to have been nearshore marine to non-marine, and similar to the lower Miocene injection interval (page 3-19). The top of the upper Miocene injection interval is approximately 2,400 feet above the top of the lower Miocene injection interval, and is interpreted in the petition to be part of the Lagarto or upper half of the undifferentiated Miocene section at the site. The upper Miocene injection interval is laterally continuous over the AOR with a net permeable sand thickness ranging from less than 50 feet, northwest of the plant site, to over 250 feet east of the plant (see Appendix 3-11). The strike and dip cross sections display the lateral variation in sand thickness in the area surrounding the Bay City Plant. Based on this, an average value of 165 feet was selected as the average thickness of this unit for use in modeling in Section 2 of this petition (page 3-19).

The physical properties of the injection sand have been determined from whole and sidewall core samples taken from WDW-8, 14 and 32 (Appendix 2-9). The average porosity from all core samples is 33.3%, with a range from 35.4% in WDW-8 to 30.1% in WDW-14 (page 3-19). Based on this, an average value of 33% was used as the porosity of this unit in modeling in Section 2 of this petition. Copies of the original core reports for these wells are contained in Section 2 of the petition (see Appendix 2-9). The permeability values range from 854 millidarcies in WDW-8 to 161 millidarcies in WDW-14. The permeability obtained from WDW-32 (465 millidarcies) lies between the preceding values. Another source of permeability data is the analysis of pressure tests in WDW-14 and WDW-49, where permeability is expressed as a product of permeability and injection sand thickness ( $kh$ ) (Collins, 1975). If an injection sand thickness of 165 feet is used, then the permeability values for WDW-14 and WDW-49 are 1394 and 1364 millidarcies, respectively (page 3-19). Based on this, an average value of 1350 millidarcies was selected as the average permeability of this unit in the modeling in Section 2 of this petition. The permeability values obtained from pressure tests are generally considered to be more reliable than core measurements because pressure tests occur under subsurface

core samples from WDW-8, the injection sand has significant clay content (Appendix 2-9). The overall composition of the sand is probably similar to the lower Miocene injection sand (deposited in similar environments) with a somewhat higher clay content (page 3-20).

A chemical analysis of the upper Miocene formation fluid has been performed and the data is included in Section 6 of this petition (see Tables 6-26 and 6-27).

Immediately above the top of the upper Miocene injection interval is a shale layer approximately 50 - 75 feet thick that is part of the permitted injection zone (Type Log, Appendix 2-7). This is the shale layer into which the upward waste movement at the site (due to the various transport processes) will be contained for 10,000 years. Page 3-20 of the petition notes that since this containing unit is based on the regulatory and permitting terminology and is not a specifically defined geological unit based on time markers, it has not been isolated and mapped as a specific unit.

The confining zone is located immediately above the top of the permitted injection zone and is predominately shale with minor discontinuous sand lenses (page 3-20). These sediments are interpreted in the petition to be also part of the Lagarto or upper half of the undifferentiated Miocene section at the site. The thickness of the confining zone ranges from approximately 375 feet to 450 feet within the AOR (see Appendix 3-12). The lateral continuity of the confining zone is exhibited in the strike and dip cross sections. The confining zone is approximately 90% shale with continuous and discontinuous sand units interspersed, and this is the principal confining unit for the site since all injection at the Bay City plant takes place below this geologic unit, and all upward waste movement at the site should be contained in the permitted injection zone below this confining unit (see section of this summary report covering modeling).

2. Numerical values used in calculations  
(pages 2-17, 2-19, 2-96, and 2-98, and attached Table 2-1)  
Q = Injection rate (bbls/day)

T = Transmissivity (mdft)  
S = Storage coefficient  
t = Time since injection began (hours)  
u = viscosity (centipoise)  
K = Reservoir permeability (millidarcies)  
b = Reservoir thickness (ft)  
c = Compressibility (psi<sup>-1</sup>)  
o = porosity (decimal)

2-1, page 2-17. The historical monthly injection rates (in gallons per minute) for injection through the end of 1987 are displayed in Appendix 2-8, page 2-96. The yearly injection rate (gallons per minute) for the average and maximum injection cases through the Year 2000 are displayed in Appendix 2-10, page 2-98 (see yearly job files), average and maximum permitted injection rates). The transmissivity values for the upper and lower injection intervals, as derived from reservoir tests, are 225,000 and 268,268 millidarcy feet, respectively (see Table 2-2, page 2-19). The storage coefficients derived in the model for the upper and lower injection intervals are 0.0004291 and 0.0005253, respectively (see derived parameters in the computer printouts from modeling, Appendix 2-10, page 2-98).

RESERVOIR HEAD/PRESSURE (ft/psi): (pages 2-24 & 2-25)

- 1) upper injection interval original formation pressure at 3440 feet BGL (below ground level) was 1554 psi, calculated from a drill stem test on WDW-8.
- 2) lower injection interval original formation pressure at 5793 feet BGL was 2631 psi, determined by a pressure measurement in WDW-110.

Method used to determine the reservoir head/pressure:  
(Pages 2-14 and 2-25)

The original formation pressure in the upper injection interval was derived from drill stem test data and bottom hole pressures reported in the area (page 2-24). The original formation pressure in the lower injection interval was determined from a bottom hole pressure measured in WDW-110, prior to the start of injection (page 2-25).

LOWERMOST USDW HEAD/PRESSURE (ft/psi): 1350 feet (estimated)

Method used to determine the lowermost USDW head/pressure:

There are no data currently available on the pressure head of the lowermost USDW at the Bay City plant site, since the lowermost aquifers have not been utilized for water supply. However, publications of the TBEG and TDWR/TWC indicate that the Evangeline Aquifer system has hydrologic continuity with the aquifer sand outcrops, and that the system is not abnormally pressurized. Consequently, it is a reasonable assumption to place the potentiometric surface of the aquifer sands at or near ground level (1350 feet of head). Water with a TDS of 10,000 ppm would have a density of approximately 1.007, which would result in a BHP at 1350 feet BGL of 589 psi.

Aquifer	Depth	Head	Reference
Chicot	200-700 300-1000	9 BGL 17 BGL	(Figure 3-7, page 3-25) (Figure 3-8, page 3-26)

3. Information submitted on the hydrogeology of the injection and confining zone. (pages 2-15 to 2-25d, 3-17 to 3-20)

- Appendix 2-9 - Laboratory Results (Core Reports)
- Appendix 3-4 - Type Logs
- Appendix 3-5 - Structure Map: Top of Lower Miocene Injection Interval
- Appendix 3-6 - Structure Map: Top of Lower Miocene Shale Layer
- Appendix 3-7 - Structure Map: Top of Upper Miocene Injection Interval
- Appendix 3-8 - Structure Map: Top of Upper Miocene Confining Zone
- Appendix 3-9 - Net Sand Isopach: Lower Miocene Injection Interval
- Appendix 3-10 - Gross Interval Isopach: Lower Miocene Shale Layer
- Appendix 3-11 - Net Shale Isopach: Upper Miocene Injection Interval
- Appendix 3-12 - Gross Interval Isopach: Upper Miocene Confining Zone
- Appendix 3-13 - Base of Lowermost Potentially-Usable Source of Drinking Water (USDW)
- Appendix 3-14 - Gross Interval Isopach: Base of USDW to Top of Upper Miocene Confining Zone
- Appendix 3-15 - Net Shale Isopach: Upper Miocene Confining Zone
- Appendix 3-16 - Gross Interval Isopach: Permitted Injection Zone, WDW-110
- Section 2, Reference 36 - Halliburton, 1964 (Drill Stem Test Report for WDW-8)
- Section 2, Reference 40 - Funk, R. J., 1972 (Report to TWQB on Bottom Hole Pressures at Celanese-Bay City Plant)
- Section 2, Reference 41 - Cooke, M. M., 1973, (Bottom Hole Pressure Survey for WDW-110)

4. Verification of the petition's hydrogeologic information on the injection and confining zones. (pages 7-12 and 7-13)

Much of the information provided was determined from published literature or field evidence (laboratory tests, pressure tests and measurements). Interpretation of the available data was performed by E. I. du Pont de Nemours Environmental Management Services and other reliable consultants and service companies. Maps and cross sections prepared for

5. Comparison of actual hydrogeologic data with data used in the simulator, and conservative estimation of all non-site specific parameters. (pages 2-25a, 2-25b, 2-25c [Table 2-3a], and 2-25d [Table 2-3b])

The actual hydrogeologic data compares very favorably to the parameters used in the model. The actual value was used in the modeling whenever available and judged appropriate for modeling. There is no recorded site-specific information for the following parameters: (1) shale layer [confining layer] porosities, (2) shale layer permeability, (3) fluid viscosity in shale layers, and (4) rock compressibility for all layers [sand and shale]. The values for rock compressibility, shale porosity, and shale permeability were conservatively estimated from published and unpublished studies (see Table 2-3a [page 2-25c] and Table 2-3b [page 2-25d] and 40 CFR 148.21).

6. Comparison between actual data and simulator data. (pages 2-25c and 2-25d)

The actual data and model parameters were compared in table form (see Tables 2-3a and 2-3b).

7. Does the petition contain adequate information pursuant to 40 CFR 148.21 to describe the hydrogeology of the injection and confining zones to a reasonable degree of certainty?

The petition's presentation of the geohydrology of the site appears to be consistent with and to be based on logs, core studies, field test data and reports by established service companies and consultant groups, state and federal geologic surveys, regulatory agencies, and various professional geologic societies. Collectively, these sources constitute the best available geohydrologic information for the site area, in the context of injection well operations. The identified sources of the petition's geohydrologic information are among those commonly used and relied on by experts in the field. As such, the petition's presentation of the geohydrology of the site appears to be consistent with 40 CFR 148.20 and 40 CFR 148.21, which specify the necessary requirements for successful petition demonstrations.

1) Formation Fluid Analysis

discussion follows

2) X-Ray Diffraction Studies

answered previously see  
HYDROGEOLOGY question #1

3) Core Reports

answered previously see  
HYDROGEOLOGY question #1

Formation Fluid Analysis - Upper and Lower Miocene (pages 6-38 & 6-39)

Chemical analyses of the formation water for the upper Miocene injection interval (1969) and lower Miocene injection interval (1976) are presented in Section 6 of the petition.

In the 1976 analyses samples of the lower Miocene injection interval fluid were obtained from three 55-gallon lined drums containing the fluid samples (page 6-38). These drums of formation fluid were obtained during the drilling of WDW-110 in the second quarter of 1973. The chemical analyses of the lower Miocene fluid samples are shown in Table 6-25.

As can be seen from the chloride analysis of all three samples, the formation water has a high salinity concentration. Sample II, while identical with Samples I and III on chlorides, differs significantly in total suspended and volatile solids, organic carbon, and color. It is believed that this particular sample was contaminated since all three samples were taken at the same point in the formation (page 6-39). Chemical analyses of the upper Miocene formation fluid were done in 1969 and the results are shown in Table 6-26.

Formation Fluid Properties - Upper Miocene (page 6-40)

As part of an engineering study (Core Labs, 1964), the characteristics of the formation fluid of the upper Miocene injection sand were also analyzed and reported in Table 6-27.

Formation Fluid Viscosity and Density (page 2-21 to 2-23)

Formation fluid viscosity has been reasonably determined from the sodium chloride concentration and the formation temperature. The formation temperatures for the injection sands were derived from temperatures recorded during drill stem tests, bottom hole pressure tests and temperature surveys. Based on this data, the formation temperatures for the upper and lower Miocene injection interval are 113°F and 137°F, respectively (page 2-21). Fluid samples recovered in WDW-110 from the lower Miocene injection

Using the above values, the viscosities for the upper and lower Miocene injection interval fluids are 0.71 centipoise (cp) and 0.64 cp, respectively (page 2-23). The formation fluid viscosities for the non-injection sand layers and shale layers were extrapolated from the injection interval fluid viscosities (pages 2-23).

The densities of the formation fluids have been determined from formation temperatures and salinities. Based on the above values, the density of the formation fluid in the upper Miocene injection interval is approximately 1.045 gm/cc (page 2-23). The formation fluid in the lower Miocene injection interval has a density of approximately 1.067 gm/cc (page 2-23).

The range of density for the waste being injected into the upper Miocene injection interval is from 1.0012 gm/cc to 1.0034 gm/cc. The average density of waste injected into the lower Miocene injection interval is approximately 1.00155 gm/cc (page 2-23). In both injection sands the formation fluid is denser than the injected waste, therefore the waste would tend to rise towards the top of the injection sand (page 2-23).

2. Information submitted on the geochemistry of the injection and confining zones. (pages 2-21 to 2-23, 3-17 to 3-20, and 6-38 to 6-40)

Important tables and referenced reports on the geochemistry of the injection and confining zones are as follows.

- Table 6-25 - Lower Miocene Fluid Analyses, Celanese Bay City Plant
- Table 6-26 - Chemical Characteristics of the Upper Miocene Formation Fluid, Celanese Bay City Plant
- Table 6-27 - Fluid Properties - Upper Miocene Injection Sand, Celanese Bay City Plant
- Appendix 2-9 - Laboratory Results (Core Reports)

3. Verification of geochemical information on the injection and confining zones.

Answered previously- see LOCAL GEOLOGY question #4

4. Comparison of geochemical data with the data used in the simulator, and conservative estimation of all non-site specific parameters.

Question answered previously-see HYDROGEOLOGY question #5 and LOCAL GEOLOGY question #5.

6. Does the petition contain adequate information pursuant to 40 CFR 148.21 to describe the geochemistry of the injection and confining zones to a reasonable degree of certainty?

The petition's presentation of geochemical information for the injection and confining zones appears to be consistent with and to be based on core studies, field test data, and reports from established well service companies and consultant groups. Collectively, these sources are the best available for the petition area, and are the types of information commonly used and relied on by experts in the field of petroleum engineering and injection well projects. Therefore, the petition's presentation of the geochemistry of the injection and confining zones appears to be consistent with 40 CFR 148.20 and 40 CFR 148.21, which specify the necessary requirements for successful petition demonstrations.

#### CHARACTERISTICS OF INJECTED FLUIDS

##### 1. Chemical and physical characteristics of the injected fluid.

Answered previously in section "WASTE PROPOSED TO BE EXEMPTED FROM LAND BAN RESTRICTIONS".

##### 2. Compatibility of the injected fluids with the:

- (a) injection zone and confining zone rock materials;
- (b) injection zone and confining zone fluids; and
- (c) well materials.

(a) Laboratory tests were done at the Bay City Plant where core material from the injection zone was exposed to the injected waste fluids. The tests indicated no significant compatibility problems exist at the Bay City Plant. This conclusion has been validated by the successful injection operations at the site from 1964 to present. (6-2 to 6-22)

(b) Injected fluids were indirectly tested for compatibility with formation fluids by flowing the injected waste through formation fluid saturated core plugs and measuring permeability reductions. No substantial incompatibilities were expected based on these tests. (6-2 to 6-22)

(c) Well material compatibility tests prove that adequate materials of construction were selected for both the "acid" and "neutral" injection wells. Properly selected materials of construction will minimize corrosion, reduce maintenance and repairs, provide for smooth operations and ensure a

compatibility problems were expected based on these tests.  
(6-22 to 6-33)

3. Information submitted on the chemical/physical characteristics of the injected fluids and compatibility of waste streams with rocks and fluids of the injection and confining zones and the well materials.

Petition text pages 6-1 through 6-40, and Tables 6-1 through 6-27 were submitted to describe chemical/physical characteristics of the injected fluids and compatibility.

4. Verification of chemical/physical and compatibility information for injected fluids.

Compatibility has been demonstrated over time by a history of safe, successful injection operations at the site from 1964 to the present. Also, the original data from laboratory reports has been included in the "Selected Petition References" Petition volume. (page 6-1)

5. Comparison of waste stream data with simulator input, and conservative estimation of non-site specific parameters.

There are no inputs to the model for waste characteristics. The model assumes that the density and viscosity of the waste and formation fluid are the same. However, variations in density are accounted for in the Plume Model by the "M" factor and in the Pressure Model by other means. See Discussion under COMPUTER SIMULATOR OR CODE Question # 7. (pages 2-81a and 2-81b)

Density Effects

The assumption has been made in both the Basic Plume Model and the Multilayer Pressure Model that the formation fluid and the waste have the same density. The density of the waste and formation fluid are not the same at the Bay City Plant. Miller, et al., (1986) studied the magnitude of the effect of density variations on the models. It was demonstrated that the influence of density variations can be included within the Basic Plume Model through the use of the multiplying factor. The effect of the density variations on the pressure distribution was also addressed. The pressure effect approaches zero at the center of the injection sand or interval, and remains small within the waste plume. The pressure effect is no greater than the product of the density difference (gm/cc) and half the injection sand or interval height (feet), with the effect expressed in psi. Using the lower Miocene injection sand as an example, the maximum pressure effect would be less than 3 psi within the waste plume.

important to note that model pressure matching is achieved at the midpoint of the injection sands where the density effect is near zero. (2-81a)

6. Methods used for comparison of waste stream data with simulator input data?

See COMPUTER SIMULATOR OR CODE Question # 5

7. Does the petition contain adequate information pursuant to 40 CFR 148.21 to describe the chemical/physical characteristics and compatibility of the injected fluids to a reasonable degree of certainty?

The petition's presentation of information on the chemical and physical characteristics and compatibility of the injected fluids is based on tests performed on well cores, the Celanese injected waste streams, injection interval fluids, and the well materials of construction. Collectively, these sources constitute the best available information on the Celanese-Bay City injection fluids and their possible interactions with both the rock matrix and fluids of the injection zone and with the well materials of construction. The petition's presentation of this information appears to be consistent with 40 CFR 148.20 and 40 CFR 148.21, which specify the necessary requirements for successful petition demonstrations.

JUSTIFICATION OF ASSUMPTIONS REQUIRED FOR MODEL VALIDITY

The Flow and Containment Model used in the Celanese-Bay City Plant petition makes the following assumptions (page 2-89):

- a) No barriers (faults or pinchouts) exist within the AOR that significantly effect fluid flow.
- b) Properties and thicknesses of the layers do not vary greatly with position, a single value for each parameter can adequately represent the layer.
- c) Flow is horizontal in the high permeability layers, and vertical in the low-permeability layers.
- d) Density of the waste and formation fluid are equal.

The following justifications, a. through d., are referenced to the above-listed assumptions of corresponding designation:

- a) Detailed geologic mapping and analysis indicate no barriers of significance were identified within the AOR.
- b) The thickness of layers was evaluated through detailed

value.

c)

The permeability contrast between the sand and shales in the area assure that horizontal flow in the sands will be the dominant component of waste movement. Each successive sand above the injection interval will serve to bleed off or dissipate the pressure drive for subsequent waste movement into the adjacent overlying shale. Although a component of horizontal waste movement will exist in a shale, the overriding concern for "no-migration" demonstrations is the distance of vertical travel of waste through a confining shale (40 CFR 148.21). Appendix 2-2 of the petition cites Neuman and Witherspoon, 1969, in justifying the assumption in question, whenever the permeability of the high permeability layer is at least 100 times greater than that of the adjacent aquitards (shales). Such condition is virtually always satisfied at Gulf Coast underground injection sites.

d)

Differences in the density of the waste and formation fluid have only a minor impact on the pressure model (see page 2-81a) and the use of the multiplying factor in the plume model accounts for the difference. The multiplying factor's use in the plume model also accounts for the variations in permeability within the injection intervals (for a detailed discussion see Miller, et al. (1986) in Section 2 References). There are no inputs to the model for waste characteristics. The model assumes that the density and viscosity of the waste and formation fluid are the same. However, variations in density are accounted for in the Plume Model by the "M" factor and in the Pressure Model by other means. See Discussion under COMPUTER SIMULATOR OR CODE Question # 7.

#### COMPUTER SIMULATOR OR CODE

##### 1. Name of simulator.

Five simulators were used: The Basic Plume Model, the Multilayer Vertical Permeation Model, the Flow Resistance Model, the Multilayer Pressure Model, and the Molecular Diffusion Model. (p. 2-4, 2-7, 2-11, 2-12, 2-74; Appendices 2-11, 2-12)

The simulators were developed by Chet Miller, E. I. du Pont de Nemours & Company Incorporated.

### 3. Brief summary of the simulator.

#### Basic Plume Model

The Basic Plume Model, which was introduced in Miller, et al, (1986), calculates the time-dependent lateral movement of the waste plumes during injection. It is set up as a single layer calculation, which neglects the vertical exchange of fluids between geologic strata. Therefore, a separate calculation is required for each layer into which waste is injected. The model includes the effects of multiple well interactions.

The Basic Plume Model accounts for the effects of geologic non-uniformities within the injection stratum by means of a multiplying factor concept. (p. 2-4)

#### Multilayer Vertical Permeation Model

The Multilayer Vertical Permeation Model is used to predict the distance of vertical waste movement due to convection within the injection zone. This model is an extension of an earlier development presented by Miller, et al, (1986), that includes the effects of multilayer stratigraphy and aquitard compressibility.

The Multilayer Vertical Permeation Model actually consists of two submodels that perform separate calculations for each of two time frames. The Short Term Submodel focuses on the injection period, and includes the effects of compressive fluid storage in the aquitard layers. The Long Term Submodel calculates the residual seepage obtained at very long times in the future. (p. 2-7)

#### Flow Resistance Model

The Flow Resistance Model, which calculates the critical injection zone pressure required to initiate displacement of fluid from an abandoned borehole, was originally developed by Barker (1981). This model is an expression of the force balance between: (1) the weight of the fluid column in the borehole and (2) the pressure force at the base of the fluid column. The model neglects flow resistance due to drilling mud gel strength. (p. 2-11, 2-12)

#### Multilayer Pressure Model

The Multilayer Pressure Model is used to calculate the pressure distribution within the injection formation. The model is an extension of an earlier methodology presented by Miller, et al,

one another, such by seepage through the aquitard layers and by crosstalk through wellbores perforated into multiple horizons. The model neglects the ability of the aquitard layers to compressively store fluids. (p. 2-12)

#### Molecular Diffusion Model

The Molecular Diffusion Model is used to predict the amount of vertical movement of a contaminant species due to molecular diffusion during the 10,000 year post-operational period. The model is based on the "complementary error function" solution to Fick's Second Law of diffusion, presented by Freeze and Cherry (1979).

The model calculates the concentration profile of any prescribed contaminant species within the overlying aquitard layer. This profile is calculated for the vertical region above the leading edge of the waste front that is advancing due to convection. (p. 2-74; Appendix 2-11, p. 3)

4. What information submitted in the petition was reviewed to determine the nature and suitability of the simulator for the injection activity?

Documentation of the theory and implementation of the simulators was submitted. (p. 2-4, 2-7, 2-11, 2-12, 2-74; Appendices 2-1, 2-2, 2-3, 2-11, 2-12)

5. How was it determined that the simulator was/was not suitable for the injection activity?

Program documentation submitted in the petition was reviewed. (p. 2-4, 2-7, 2-11, 2-12, 2-74; Appendices 2-1, 2-2, 2-3, 2-11, 2-12)

6. How was the simulator verified/validated?

The Basic Plume Model results were favorably compared to an analytical solution by Muskat (1946) and numerical solutions by Collins (1961) and Javandal, et al, (1984). (p. 2-81a; Appendix 2-1, p. 28 through 30)

The Vertical Permeation Model results were compared to hand calculations for specific pressure histories and to an analytic solution presented in Miller, et al, (1986). (Appendix 2-3, p. 26 through 28)

The Flow Resistance Model performs a simple hydrostatic pressure calculation. Therefore, verification of the solution of the equation was not discussed. (p. 2-11, 2-12)

The Molecular Diffusion Model evaluates a simple mathematical expression, using the "complementary error function", which is available in published tabulations and computer function libraries. Therefore, verification of the solution of the equation was not discussed. (Appendix 2-12, p. 6)

7. How were the assumptions of the simulator addressed?

The assumptions for the Basic Plume Model are as follows:

- a. The flow is incompressible.
- b. Permeation from the injection interval into the overlying and underlying aquitards is negligible.
- c. Properties of the injection interval do not vary with position.
- d. Densities of the waste and formation fluids are equal.
- e. The fluid viscosity is uniform within the injection interval.
- f. The injection interval is fully perforated.

The assumptions are conservative, their impact is small, or can they are accounted for through the use of the multiplying factor. (Appendix 2-1, p. 5 through 8)

The assumptions for the Multilayer Vertical Permeation Model are as follows:

- a. Flow is horizontal in the high-permeability layers, and vertical in the low-permeability layers.
- b. The properties and thicknesses of the layers do not vary with position.
- c. Fluid viscosity is uniform within each layer of the model.
- d. The injection intervals are fully perforated.
- e. Hydrodynamic dispersion can be discounted in the aquitard layers.

The assumptions are conservative or their impact is small. (Appendix 2-3, p. 11 through 14)

The assumptions for the Flow Resistance Model are as follows:

- a. Abandoned boreholes contain a column of drilling mud that extends to the surface.
- b. The only available exit for the drilling mud is the ground surface at the top of the borehole (the drilling mud will not exit the borehole at the depth of the USDW because the pores of that formation will be obscured by the suspended particles in the mud).

column height (height of the mud column above the injection interval), not just the height of the USDW. (p. 2-11, 2-12)

The assumptions for the Multilayer Pressure Model are as follows:

- a. The flow is horizontal in the high-permeability layers, and vertical in the low-permeability layers.
- b. The properties and thicknesses of the layers do not vary with position.
- c. The density of the waste is the same as that of the formation fluid.
- d. Viscosities of the waste and formation fluid are equal.
- e. Compressive storage in the low-permeability layers is negligible.
- f. The injection interval is fully perforated.

The assumptions are conservative or their impact is small. (Appendix 2-2, p. 9 through 13)

The assumptions for the Molecular Diffusion Model are as follows:

- a. The contaminant concentration at the leading edge of the waste front that is advancing due to convection is equal to the concentration in the waste stream at all times.
- b. Chemical interaction with the aquitard material is negligible.
- c. Horizontal waste movement is negligible.
- d. The waste is not heavier than the formation brine.
- e. Chemical fate of the contaminants is negligible.

The assumptions are conservative. (Appendix 2-11, p. 3 through 5; Appendix 2-12, p. 28 through 31)

#### BOUNDARY CONDITIONS

##### 1. Brief summary of the boundary conditions used in the model.

With exception of a small fault located northwest of the site, and with exception of minor thinning several miles from the site, no potential boundaries were observed in the geological study. The length and displacement of the fault is quite small, and the thinning of the injection interval sands is insignificant. Therefore, no boundaries were modeled. (p. 2-81b, 2-81c, 3-16 through 3-16b; Appendices 3-2, 3-3, 3-5, 3-6, 3-7, 3-8)

##### 2. How was it determined that the boundary conditions did/did not assimilate natural physical conditions?

The Local Geology section of the petition was reviewed. (p. 3-16 through 3-16b, Appendices 3-2, 3-3, 3-5, 3-6, 3-7, 3-8)

Boundary conditions used were considered by the petitioner to be appropriate for the site.

#### **GRID DISCRETIZATION**

##### **1. Brief summary of the model grid network.**

An analytical modeling methodology was used rather than a grid model methodology.

#### **CALIBRATION**

##### **1. Brief summary of how the model was calibrated.**

Model calibration involved an interactive process. The geologic inputs were varied within a range of values until a "best fit" was achieved between the model's predictions and measured data. (p. 2-27)

The Basic Plume Model is calibrated against historical observations of lateral waste movement. These observations are based on the examination of fluids extracted from newly constructed wells at the site. (p. 2-4, 2-28 through 2-32)

The Multilayer Pressure Model is calibrated to the observed history of shut-in pressures at the wells. (p. 2-12, 2-31 through 2-42)

##### **2. How was it determined that the model was/was not sufficiently calibrated?**

Exhibits presented in the petition clearly indicate the adequacy of the calibration of the Basic Plume Model and The Multilayer Pressure Model. The Multilayer Vertical Permeation Model, the Flow Resistance Model, and the Molecular Diffusion Model are not subject to calibration, since appropriate historical measurements cannot be obtained. (p. 2-27 through 2-42)

#### **PREDICTIVE SIMULATIONS**

##### **1. Brief summary of injection scenario(s) used in the model.**

Calculations of the present day waste distribution (through the end of 1987) were based on historical monthly injection rates. Calculations of the near future waste distribution (through the end of the year 2000) and the post-injection waste distribution were based on two scenarios: (1) injection to the end of the year 2000 at projected average injection rates (based on the average of 1986 and 1987 yearly injection rates); and (2) injection to

## Present Day Waste Distribution

The calculated distribution of waste and pressure within the upper Miocene injection sand at the end of 1987 is as follows: (1) the composite waste plume was contained within an approximate radius of 0.7 miles from WDW-32, (2) maximum permeation into the overlying confining layer was 0.833 feet at WDW-14, and (3) maximum pressure increase over original formation pressure was approximately 30 psi at WDW-14.

Within the lower Miocene injection sand, the calculated distribution of waste and pressure at the end of 1987 is as follows: (1) the waste plume was circular with a radius of approximately 0.4 miles from WDW-110, (2) maximum permeation into the overlying confining layer was 0.062 feet at WDW-110, and (3) maximum pressure increase was approximately 31 psi at WDW-110. (p. 2-40 through 2-46, 2-77)

## Near Future Waste Distribution

The modeling results for the upper Miocene injection sand at the end of the year 2000, using maximum permitted injection rates are as follows: (1) the composite waste plume will be contained within a 0.90 mile radius of WDW-32, (2) maximum vertical permeation will be 1.520 feet at WDW-14, and (3) maximum pressure increase will be 87 psi at WDW-14.

The modeling results at the end of the year 2000 within the lower Miocene injection sand, using maximum permitted injection rates are as follows: (1) the waste plume will be contained within a 0.77 mile radius of WDW-110 (p. 2-77 says 0.75 miles), (2) maximum vertical permeation will be 0.196 feet at WDW-110, and (3) maximum pressure increase would be 86 psi at WDW-110. (p. 2-46 through 2-59, 2-77)

## Post-Injection Waste Distribution

Based on maximum permitted injection rates, post-injection modeling results for the upper Miocene injection sand are as follows: (1) pressure at WDW-14 will decline to 16 psi above original formation pressure in 1 year and to less than 3 psi above original formation pressure in 30 years, (2) maximum vertical permeation will be 1.551 feet, (3) the molecular diffusion distance through intact rock will be 43.1 feet in 10,000 years, (4) the combined distance of vertical movement due to convection and molecular diffusion through intact rock will be 44.65 feet, and (5) the waste plume will be contained within a 5 mile radius of the plant site for 10,000 years.

Post-injection modeling results for the lower Miocene injection

permeation will be 0.202 feet, and (3) the waste plume will be contained within a 2.5 mile radius of the plant site for 10,000 years. (p. 2-59 through 2-76e, 2-78; Appendix 2-11, p. 9 through 11)

3. How was it determined that the results were/were not accurate?

See SENSITIVITY ANALYSIS and CONCLUSIONS.

#### SENSITIVITY ANALYSIS

1. Brief summary of the method used in performing the sensitivity analysis.

The sensitivity of the Basic Plume Model, the Multilayer Vertical Permeation Model, and the Multilayer Pressure Model to changes in input parameters was evaluated by varying the input values for injection sand thickness, injection sand porosity, injection sand permeability, and formation fluid viscosity by approximately 10% from the original value, and by varying the input values for injection sand compressibility and confining layer permeability by one order of magnitude from the original value. The corresponding input parameters for each injection sand were varied one at a time until all parameters had been evaluated. The sensitivity analysis was based on injection at maximum permitted injection rates into both injection sands.

The sensitivity of the Molecular Diffusion Model to changes in input parameters was also evaluated. The input value for the porosity of the shale layers above the injection interval was varied from 12% to 10% and from 12% to 14%, and the input value for the free water diffusion coefficient for the diffusing molecule was varied 10% from the original value. (p. 2-78, 2-79; Appendix 2-11, p. 9, 10)

2. Discuss the consequence of the sensitivity analysis in relation to the model results.

Within the range of input values considered in the sensitivity analysis, the predicted plume radius at the end of the year 2000 is within 0.04 miles of the maximum value, the predicted pressure increase over original formation pressure at the end of the year 2000 is within 11 psi of the maximum value, the predicted upward permeation into the overlying confining shale at the end of the year 2000 is within 4 feet of the maximum value, the predicted molecular diffusion distance through intact rock at the end of 10,000 years is within 7.5 feet of the maximum value, and the predicted combined distance of vertical movement due to convection and molecular diffusion through intact rock at the end of 10,000 years is within 11 feet of the maximum value. (p.

**1. Discussion of sources of possible model error.**

The petition expresses concern over health based limits uncertainty and the determination of appropriate concentration reduction factors. (p. 2-76d; Appendix 2-11, p. 10)

Molecular diffusion through an abandoned borehole is not considered.

**2. Discussion of potential problems in the migration analysis.**

An appropriate concentration reduction factor must be used to correctly determine the lateral dispersion of the plume and to correctly determine vertical molecular diffusion distances.

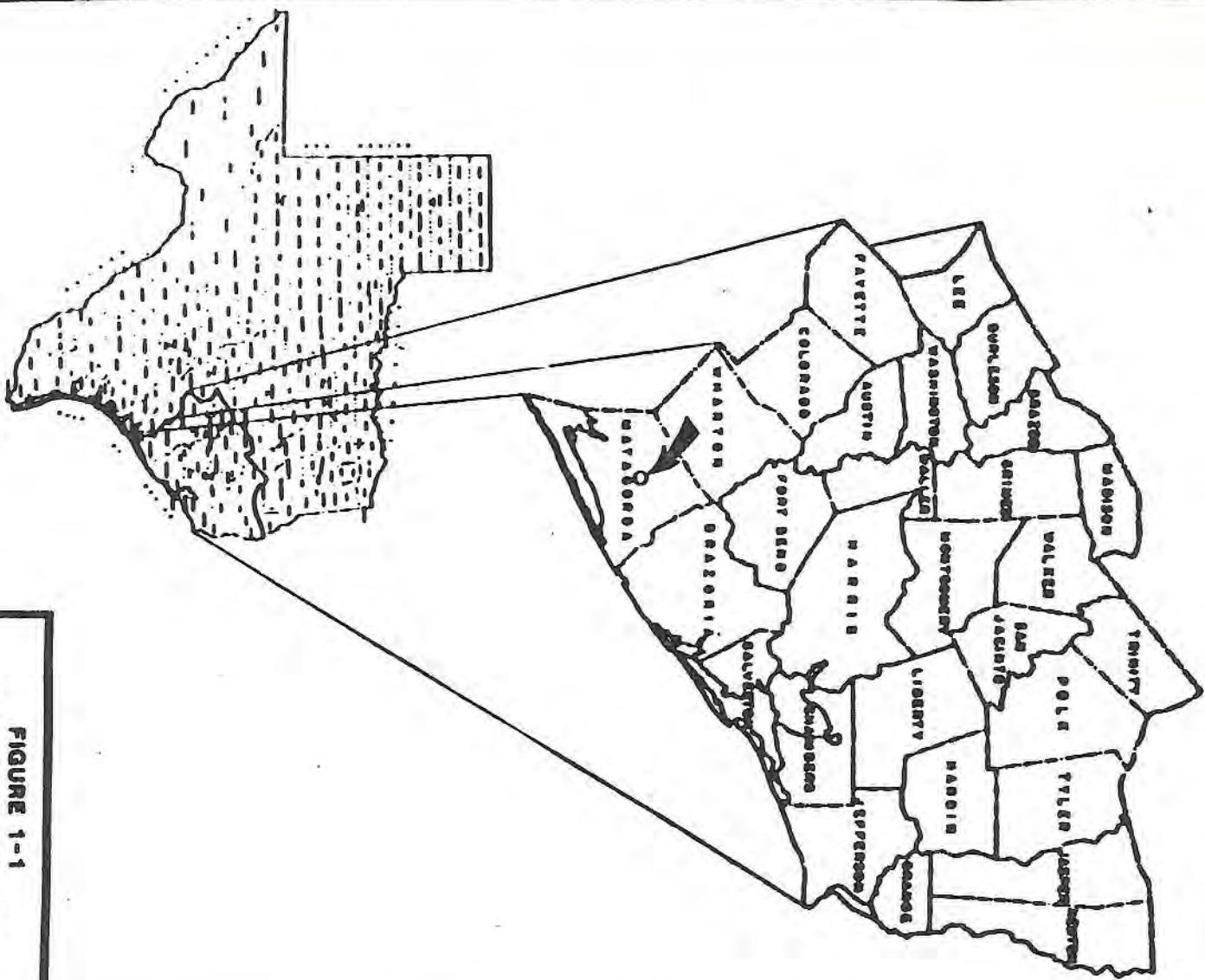
In other petitions, the Molecular Diffusion Model has been used to calculate not only the distance of molecular diffusion through intact rock, but also the distance of molecular diffusion through an abandoned borehole. Application of the model to calculate the distance of molecular diffusion through an abandoned borehole at this site is easily accomplished, and doing so indicates a distance of vertical waste movement that is greater than the maximum distance of vertical waste movement currently presented in this petition.

**3. Discussion of how the model results did/did not meet the requirements stated in the regulations.**

The depth of the top of the injection zone is not correctly stated in the petition. The petition indicates that the top of the injection zone is at a depth of 3300 feet, 50 feet above the top of the upper Miocene injection sand. In reality, the injection well permits establish the top of the injection interval at a depth of 3300 feet. In the meantime, adequate confining material is thought to exist for establishment of an injection zone and a confining zone that are protective of USDW (including consideration of molecular diffusion in an abandoned wellbore).

According to EPA regulations, the operator must demonstrate, to a reasonable degree of certainty, that there will be no migration of hazardous constituents, over a time span of 10,000 years, vertically out of the injection zone or laterally to a point of discharge or interface with a USDW. In order to demonstrate that there will be no migration vertically out of the injection zone, the distance of molecular diffusion in an abandoned wellbore should be submitted by the petitioner.

The petitioner has followed for the most part the regulations set forth in 40 CFR Part 148. The only point of contention at this time would be the lack of discussion as to the extent of molecular diffusion up an abandoned wellbore.



**FIGURE 1-1**  
**SITE LOCATION MAP**  
**HOECHST CELANESE**  
**CHEMICAL GROUP, INC.,**  
**BAY CITY PLANT**  
**MATAGORDA COUNTY, TEXAS**

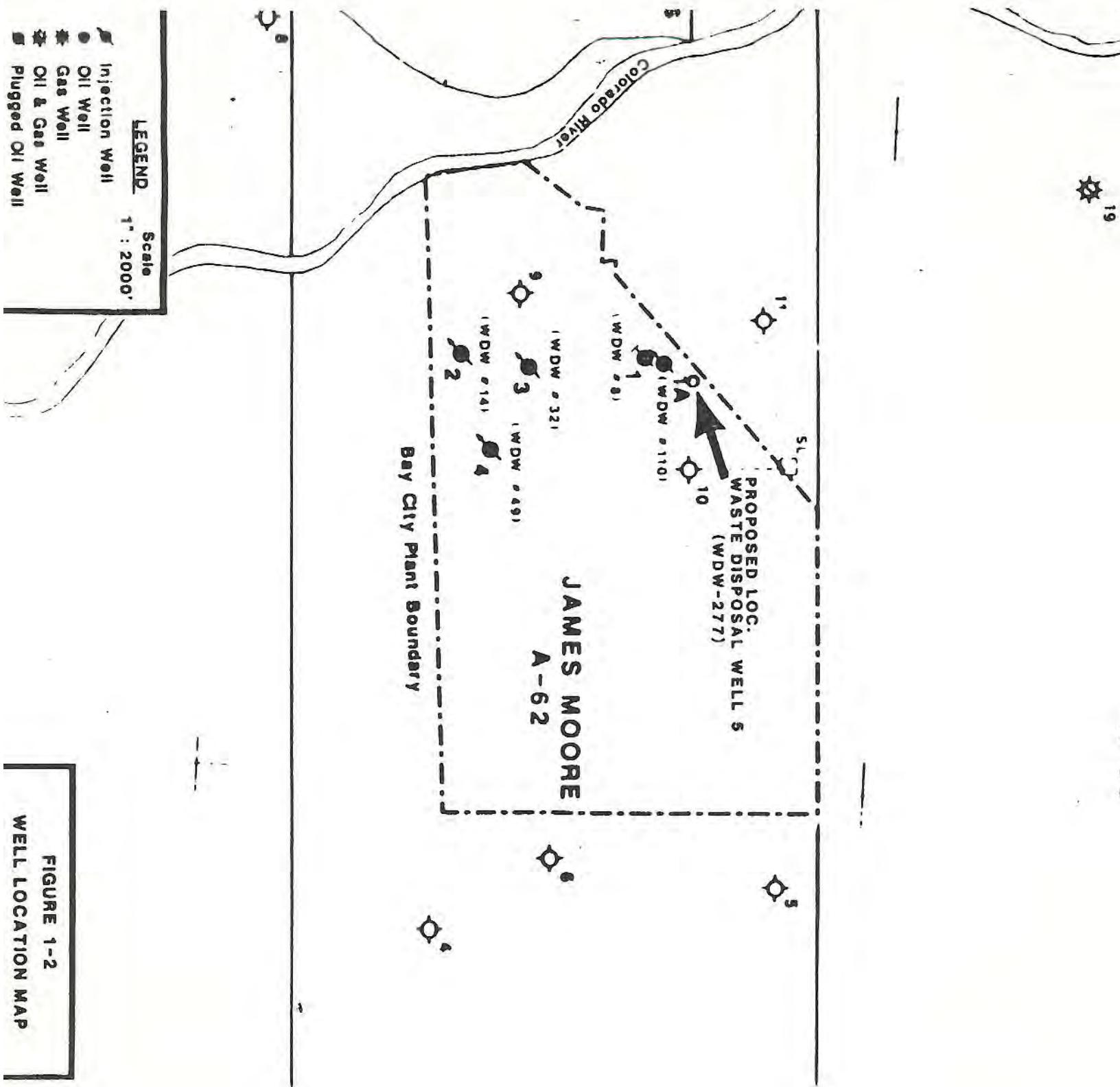


FIGURE 1-2  
WELL LOCATION MAP

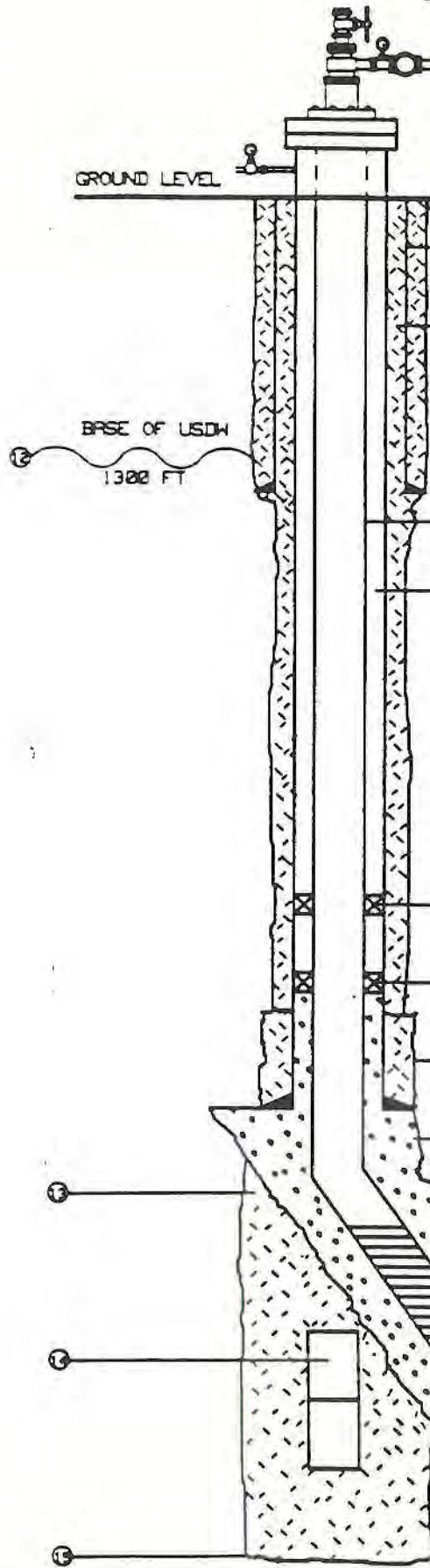
**Table 7-1**  
**Chemical Analyses of Acid Waste and Neutral Waste \***  
**Analyses Done September 22, 1987**  
**Hoechst Celanese Chemical Group, Inc., Bay City Plant**

Analysis	(WDW-110, WDW-277) Acid Wells Feed	(WDW-14, 32, 49) Neutral Wells Feed
Specific Conductance (umhos)	1,250	5,000
Alkalinity (ppm)	<1	3,820
Hardness (ppm)	<1	13,500
Phosphorous - Ortho (ppm)	<1	10.2
Phosphorous - Total (ppm)	<1	10.2
Oil and Grease (ppm)	<5	<5
Ash (%)	0.0147	0.081
Water (%)	99.29	99.3
Nitrate (ppm)	<0.1	1.8
Total Organic Carbon (ppm)	4826	4934
Total Suspended Solids (ppm)	5	13
Total Dissolved Solids (ppm)	504	1,710
pH	2.07	6.41
Chemical Oxygen Demand (ppm)	16,854	19,101
Specific Gravity	1.0044	1.0048
Total Cyanides (mg/l)	<0.005	<0.005
Total Phenols (mg/l)	0.030	0.020
Antimony (mg/l)	<0.005	<0.005
Arsenic (mg/l)	<0.005	0.180
Barium (mg/l)	<0.050	<0.005
Cadmium (mg/l)	<0.005	61
Calcium (mg/l)	45	0.23
Chromium (mg/l)	<0.01	2.79
Copper (mg/l)	0.31	<0.005
Lead (mg/l)	<0.005	0.40
Manganese (mg/l)	0.02	<0.002
Mercury (mg/l)	<0.002	3.3
Nickel (mg/l)	0.022	128
Sulfate (ppm)	37	<0.005
Selenium (mg/l)	<0.005	<0.005
Silver (mg/l)	<0.005	<0.005
Thallium (mg/l)	<0.005	0.15
Vandadium (mg/l)	<0.005	0.47
Zinc (mg/l)	0.01	304
Halogenated Organic Compounds (HOC)(ppm)	1772	

\* Taken from regular bi-annual waste analyses performed at the Bay City Plant.

FIGURE 5-1  
 HOECHST CELANESE  
 CHEMICAL GROUP, INC.,

BAY CITY PLANT  
 INJECTION WELL 1A  
 (WDW-110)  
 STATUS: ACTIVE



COMPLETION DETAIL

1. CONDUCTOR CASING - 68 FT., 20 IN., DRIVEN
2. SURFACE CASING - 1396 FT., 13 3/8 IN., 54.5 LB./FT., K-55, CEMENTED TO SURFACE W/950 SX. HALLIBURTON LITE AND 388 SX. TRINITY TYPE A CEMENT.
3. PROTECTIVE CASING - MIXED STRING AS FOLLOWS: 4624 FT., 9 5/8 IN., 48 LB./FT., K-55, & 1032 FT., 9 5/8 IN., 43.5 LB./FT., N-80, FROM 4624 FT. - 5656 FT. CEMENTED TO SURFACE IN TWO STAGES:  
 LOWER STAGE - 440 SX. DOWELL LITEWATE AND 1218 GALS. EPOXY ACID RESISTANT PLASTIC RESIN CEMENT.  
 UPPER STAGE - 820 SX. DOWELL LITEWATE AND 1812 GALS. EPOXY ACID RESISTANT PLASTIC RESIN CEMENT.
4. INJECTION TUBING - 5630 FT., 5 1/2 IN., 2800 LB., FIBERCAST.
5. ANNULUS FLUID - INHIBITED BOILER FEEDWATER
6. PACKER - 5037 FT., RPS.
7. PACKER - 5631 FT., TEXAS IRON WORKS, L63.
8. 5657 FT. - 5677 FT., CUT TO 16 IN., FILLED WITH EPOXY CEMENT, AND DRILLED OUT W/0.187 O.D. MILL.
9. UNDERREAMED HOLE - 5710 FT. - 5922 FT., PACKED W/247 SX. 40-60-90 MESH GRAVEL.
10. SCREEN - 5650 FT. - 5921 FT., 6 5/8 IN. O.D., LAYNE BOWLER 316 SS.
11. TOTAL DEPTH - 5922 FT.
12. BASE OF USDW (TDS=18,000 ppm) - 1380 FT.
13. UNDERREAMED HOLE - 5700 FT. - 5769 FT., 18 IN., CEMENTED W/410 SX. DOWELL CLASS H CEMENT.
14. FALLEN CASING AND CEMENT SHOE - 5790 FT.
15. ORIGINAL HOLE TOTAL DEPTH - 5935 FT.

NOTE: DIAGRAM NOT DRAWN TO SCALE

WELL CONSTRUCTION: INJECTION WELL 1A (WDW-110)

DATE DRILLED:	5/21/73	5-1	PERFORATED:	
DATE OF FIRST INJECTION:	6/73	2-96	OPEN HOLE:	
TOTAL DEPTH:	5935	5-5	SCREENED:	5650-5921 5-5

CASING:

SURFACE CASING:	DIAMETER <u>13 3/8"</u>	DEPTH <u>1396'</u>	GRADE <u>K-55</u>	HOLE SIZE <u>18 1/2"</u>	5-32
INTER. CASING:	<u>9 5/8</u>	<u>4624</u>	<u>K-55</u>		
LONG STR. CASING:	<u>9 5/8</u>	<u>4624-5656</u>	<u>N-80</u>	<u>12 1/4</u>	5-32
TUBING:	<u>5 1/2</u>	<u>5630</u>	Fiberglass systems		

PACKER: X Yes 5-5 No

PACKER DEPTH: 5037' & 5631' 5-5

ANNULAR FLUID: Inhibited Boiler Feedwater 5-5

<u>CEMENT:</u>	<u>CLASS (ADDITIVES)</u>	<u>SACKS</u>	<u>YIELD (ft<sup>3</sup>/sx.)</u>	<u>TOC</u>	<u>DETER. OF TOC</u>
<u>SURFACE:</u>	Halliburton Lite	950	5-2 1.62		Cmt Ret Noted 5-2
	Trinity Class A	300	5-2 1.18	Surface 5-2	at Surf
	Dowell Litewate	440	5-2 2.12		
<u>LONG STR:</u>	Epoxy Acid Resist.	1218 gals	5-2		
	Dowell Litewate	820	5-2 2.12		Cmt Ret Noted 5-2
	Epoxy Acid Resist.	1812 gals	5-2	Surface 5-2	at Surf

INITIAL COMPLETION STIMULATION:

DATE: 7/14/73

Description (type, pressure, volume, etc.): 1000 gals 28% HCl 3000 gals 6% HF, & 1000 gals 28% HCl.

Effect on injection and confining intervals:

Acidization to the well increases injectivity (permeability & porosity). The acid does not come in contact with the confining zone. 6-58a

Subsequent Well Stimulations:

(Please provide the following for each stimulation)

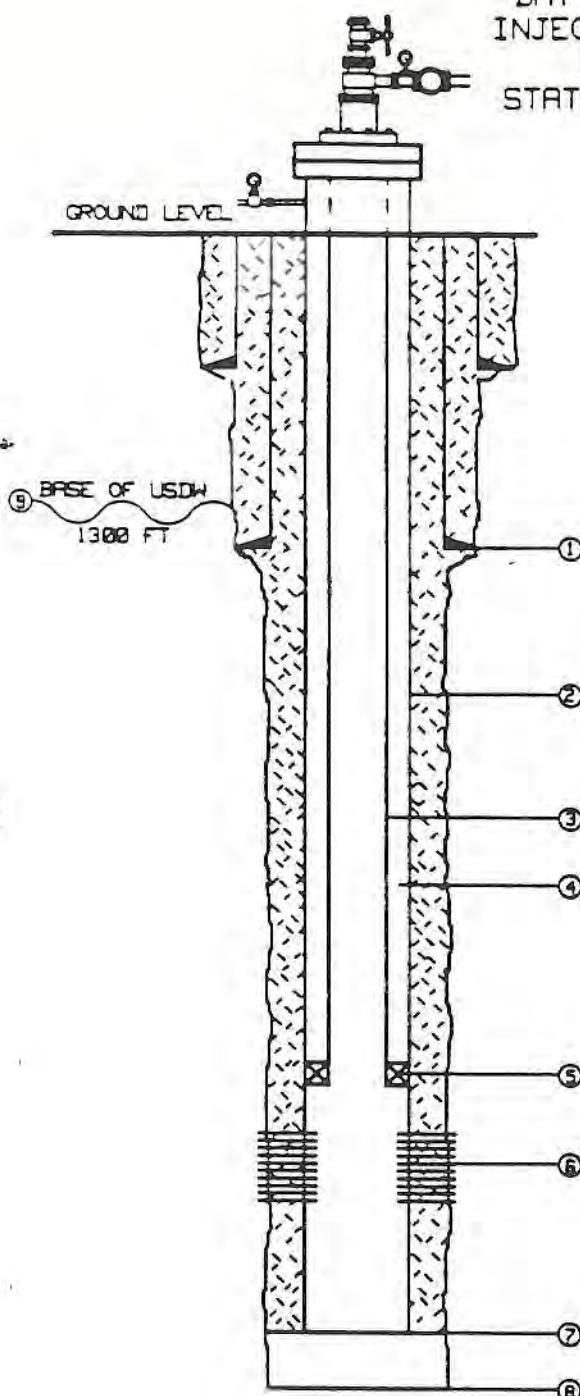
DATE: 8/23/73 6-58b

Description (Type, pressure, volume, etc.): \_\_\_\_\_

Effect on injection and confining intervals:

Refer to 6-58a.

FIGURE 5-2  
 HOECHST CELANESE  
 CHEMICALS GROUP, INC.,  
 BAY CITY PLANT  
 INJECTION WELL 2  
 (WDW-14)  
 STATUS : ACTIVE



COMPLETION DETAIL

1. SURFACE CASING - 1369 FT., 13 3/8 IN., 48 LB./FT., H-40, CEMENTED TO SURFACE W/460 SX. LONGHORN COMMON PND 200 SX. COMMON CEMENT.
2. PROTECTIVE CASING - 3750 FT., 9 5/8 IN., 40 LB./FT., J-55, CEMENTED TO SURFACE W/501 SX. LONE STAR PND 501 SX. 50/50 POZMIX.
3. INJECTION TUBING - 3162 FT., 5 1/2 IN., 15.5 LB./FT., J-55.
4. ANNULUS FLUID - 10 LB./GAL. INHIBITED BRINE.
5. PROXER - 3162 FT., TEXAS IRON WORKS, 6 5/8 IN., "JGS".
6. PERFORATIONS - 3450 FT. - 3520 FT. (2SPF), 3520 FT. - 3550 FT. (6SPF).
7. CASING AND GUIDE SHOE - CEMENTED TO SURFACE FROM 3750 FT.
8. TOTAL DEPTH - 3780 FT.
9. BASE OF USDW (TDS-10,000 PPM) - 1300 FT.

NOTE: DIAGRAM NOT DRAWN TO SCALE

PAGE REVISED

MAY 17 1969

WELL CONSTRUCTION: INJECTION WELL 2 (WDW-14)

DATE DRILLED: 12/26/64 <sup>5-7</sup> PERFORATED: 3450'-3550' <sup>5-11</sup>  
DATE OF FIRST INJECTION: 4/64 <sup>2-96</sup> OPEN HOLE: \_\_\_\_\_  
TOTAL DEPTH: 3780 <sup>5-7</sup> SCREENED: \_\_\_\_\_

CASING:

	DIAMETER	DEPTH	GRADE	HOLE SIZE
SURFACE CASING:	<u>13 3/8"</u> <sup>5-11</sup>	<u>1369'</u> <sup>5-11</sup>	<u>H-40</u> <sup>5-11</sup>	<u>17"</u> <sup>5-7</sup>
INTER. CASING:	_____	_____	_____	_____
LONG STR. CASING:	<u>9 5/8</u> <sup>5-11</sup>	<u>3750</u> <sup>5-11</sup>	<u>J-55</u> <sup>5-11</sup>	<u>12 1/4</u> <sup>5-7</sup>
TUBING:	<u>5 1/2</u> <sup>5-11</sup>	<u>3162</u> <sup>5-11</sup>	<u>J-55</u> <sup>5-11</sup>	_____
PACKER:	<u>X</u> Yes <sup>5-11</sup>	_____	No <sup>5-11</sup>	_____
PACKER DEPTH:	<u>3162'</u> <sup>5-11</sup>			_____

ANNULAR FLUID: 10 lb/gal Inhibited brine. <sup>5-11</sup>

<u>CEMENT:</u>	<u>CLASS</u>	<u>SACKS</u>	<u>YIELD</u> (ft. <sup>3</sup> /sx <sub>2</sub> )	<u>TOC</u>	<u>DETER. OF TOC</u>
<u>SURFACE:</u>	<u>(ADDITIVES)</u> <u>Longhorn Common</u> <sup>5-7</sup>	<u>460</u> <sup>5-7</sup>	<u>2.34</u> <sup>5-32</sup>	<u>Surface</u> <sup>5-7</sup>	<u>Cmt Ret Noted</u> <sup>5-7</sup>
<u>INTER:</u>	<u>Lone Star Inc.</u> <sup>5-8</sup>	<u>501</u> <sup>5-8</sup>	<u>1.36</u> <sup>5-32</sup>	<u>at surf</u>	<u>Cmt Ret Noted</u> <sup>5-8</sup>
<u>LONG STR:</u>	<u>50/50 Pozmix "A"</u> <sup>5-8</sup>	<u>501</u>	<u>1.26</u> <sup>5-32</sup>	<u>Surface</u> <sup>5-8</sup>	<u>at surf</u> <sup>5-8</sup>

INITIAL COMPLETION STIMULATION:

DATE: No initial stimulation required.

Description (type, pressure, volume, etc.): Not Applicable

Effect on injection and confining intervals:

Not Applicable

Subsequent Well Stimulations: Acid Stimulations, type unknown on

11/21/68 <sup>(6-58b)</sup>, 12/5/68 <sup>(6-58b)</sup>

(Please provide the following for each stimulation)

DATE: 2/6/80 <sup>6-58b</sup>

Description (Type, pressure, volume, etc.): 1000 gals 15% HCl, 5000 gals

12% HCl/3% HF, 1000 gals HCl (performed 2/6/80). <sup>6-46</sup>

Effect on injection and confining intervals:

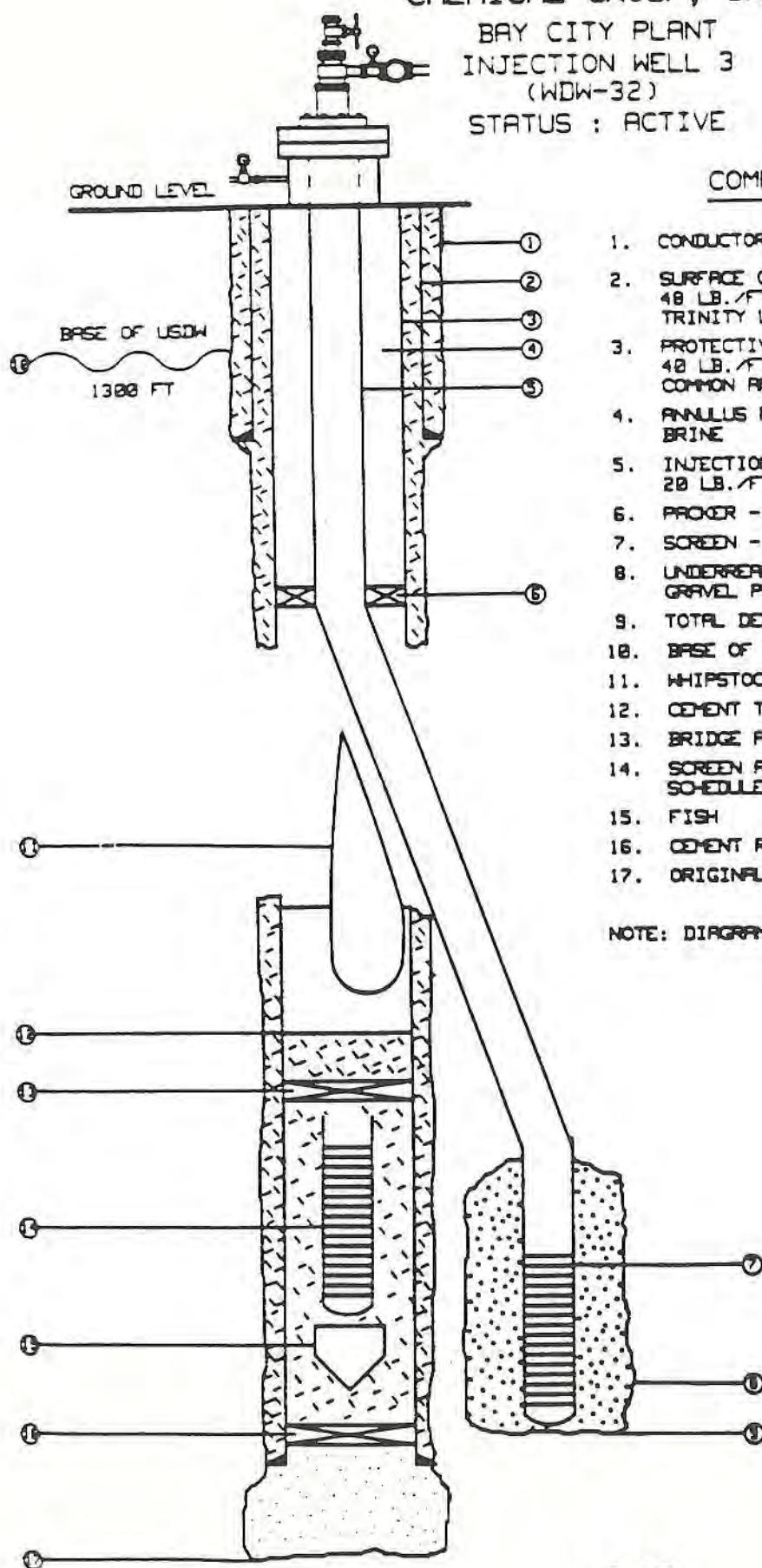
Acidization increases the porosity and permeability of the injection zone.

The acid does not come in contact with the confining zone. <sup>6-58a</sup>

FIGURE 5-3

HOECHST CELANESE  
CHEMICAL GROUP, INC.,

BAY CITY PLANT  
INJECTION WELL 3  
(WDW-32)  
STATUS : ACTIVE



COMPLETION DETAIL

1. CONDUCTOR CASING
2. SURFACE CASING - 1382 FT., 13 3/8 IN., 48 LB./FT., H-40, CEMENTED TO SURFACE W/535 SX. TRINITY LITE-WATE RND 300 SX. COMMON CEMENT.
3. PROTECTIVE CASING - 3245 FT., 9 5/8 IN., 40 LB./FT., J-55, CEMENTED TO SURFACE W/180 SX. COMMON RND 1802 SX. 50/50 POZMIX CEMENT.
4. ANNULUS FLUID - 18 LB./GAL. INHIBITED BRINE
5. INJECTION TUBING - 3168 FT., 5 1/2 IN., 20 LB./FT., N-80.
6. PACKER - 3191 FT.. TEXAS IRON WORKS, "JGS".
7. SCREEN - 3352 FT. - 3553 FT., 4 1/2 IN., 316 SS.
8. UNDERREAMED HOLE - 3525 FT. - 3553 FT., 14 IN., GRAVEL PACKED.
9. TOTAL DEPTH - 3553 FT.
10. BASE OF SIDETRACK (TDS-10,000 PPM) - 1388 FT.
11. WHIPSTOCK ASSEMBLY - 3261 FT.
12. CEMENT TOP - 3297 FT.
13. BRIDGE PLUG - 3386 FT., O.K.I.
14. SCREEN AND LINER - 3317 FT. - 3493 FT., 304 SS. SCHEDULE 40.
15. FISH
16. CEMENT RETAINER - 3546 FT.
17. ORIGINAL TOTAL DEPTH - 3710 FT.

NOTE: DIAGRAM NOT DRAWN TO SCALE

PAGE REVISED

MAY 17 1989

WELL CONSTRUCTION: INJECTION WELL 3 (WDW-32)

DATE DRILLED:	6/67	5-13	PERFORATED:	
DATE OF FIRST INJECTION:	7/67	2-96	OPEN HOLE:	
TOTAL DEPTH:	3710	5-13	SCREENED:	3352' - 3553' 5-17

CASING:

	DIAMETER	DEPTH	GRADE	HOLE SIZE	
SURFACE CASING:	13 3/8"	5-16 1302'	H-40	5-16 17" 5-13	
INTER. CASING:					
LONG STR. CASING:	9 5/8"	5-16 3608'	J-55	5-16 12 1/4" 5-13	
TUBING:	5 1/2"	5-16 3202'	N-80	5-16	
PACKER:	X Yes	5-17	No	5-17	
PACKER DEPTH:	3191'				
ANNULAR FLUID:	10 lb/gal Inhibited brine				5-17

<u>CEMENT:</u>	CLASS (ADDITIVES)	SACKS	YIELD (ft <sup>3</sup> /sx <sub>2</sub> )	TOC	DETER. OF TOC
SURFACE:	Trinity Lite Wate	535 5-13	1.54 5-32	Surface 5-13	Cmt. Ret. Noted 5-13
	Common	300 5-13	1.36 5-32	at Surf.	
INTER:	Common	5-14	100 5-14	1.36 5-32	
LONG STR:	50/50 Pozmix	5-14	1002 5-14	1.26 5-32	Surface 5-13 Cmt. Ret. Noted 5-14

INITIAL COMPLETION STIMULATION:

DATE: No initial stimulation required.

Description (type, pressure, volume, etc.): Not Applicable

Effect on injection and confining intervals:

Not Applicable

Subsequent Well Stimulations:

(Please provide the following for each stimulation)

DATE: 1/24/68 6-58b

Description (Type, pressure, volume, etc.): 2000 gals HCl 6-50

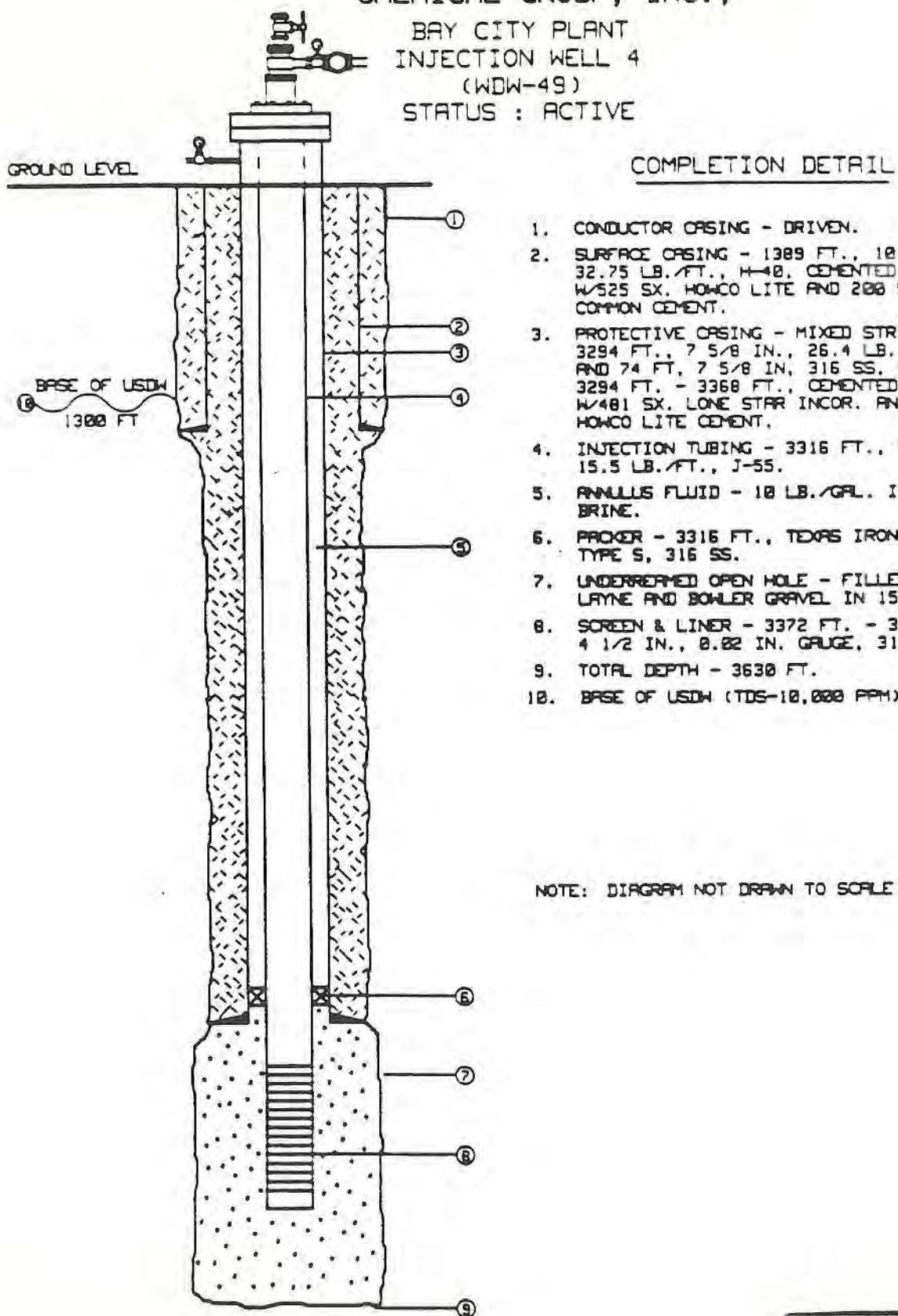
Effect on injection and confining intervals:

Acidization increases the porosity & permeability of the injection zone.

The acid does not come in contact with the confining zone. 6-58a

FIGURE 5-4

HOECHST CELANESE  
CHEMICAL GROUP, INC.,  
BAY CITY PLANT  
INJECTION WELL 4  
(WDW-49)  
STATUS : ACTIVE



PAGE REVISED  
MAY 17 1983

WELL CONSTRUCTION: INJECTION WELL 4 (WDW-49)

DATE DRILLED: 5/7/69 <sup>5-19</sup> PERFORATED: \_\_\_\_\_  
DATE OF FIRST INJECTION: 6/69 <sup>2-96</sup> OPEN HOLE: \_\_\_\_\_  
TOTAL DEPTH: 3630' <sup>5-19</sup> SCREENED: 3372'-3579' <sup>5-23</sup>

CASING:

	DIAMETER	DEPTH	GRADE	HOLE SIZE
SURFACE CASING:	<u>10 3/4"</u> <sup>5-22</sup>	<u>1389'</u> <sup>5-22</sup>	<u>H-40</u>	<u>15"</u> <sup>5-19</sup>
INTER. CASING:	<u>7 5/8"</u> <sup>5-22</sup>	<u>3294</u> <sup>5-22</sup>	<u>J-55</u>	<u>9 7/8"</u> <sup>5-19</sup>
LONG STR. CASING:	<u>7 5/8"</u> <sup>5-22</sup>	<u>3294'</u> - <u>3368</u>	<u>Sch. 40ss</u>	<u>9 7/8"</u> <sup>5-19</sup>
TUBING:	<u>5 1/2"</u> <sup>5-22</sup>	<u>3316'</u> <sup>5-22</sup>	<u>J-55</u> <sup>5-22</sup>	_____
PACKER:	<u>X</u> Yes <sup>5-23</sup>	_____	No	_____
PACKER DEPTH:	<u>3316'</u>			
ANNULAR FLUID:	<u>10 lb/gal Inhibited brine.</u>			

<sup>5-23</sup>

<u>CEMENT:</u>	<u>CLASS (ADDITIVES)</u>	<u>SACKS</u>	<u>YIELD (ft<sup>3</sup>/sx.)</u>	<u>TOC</u>	<u>DETER. OF TOC</u>
SURFACE:	Howco Lite <sup>5-19</sup>	<u>525</u> <sup>5-19</sup>	<u>1.54</u> <sup>5-32</sup>	<u>Surface</u> <sup>5-19</sup>	<u>Cmt. Ret. Noted</u> <sup>5-19</sup>
INTER:	Lone Star Inc. <sup>5-20</sup>	<u>481</u> <sup>5-20</sup>	<u>1.22</u> <sup>5-32</sup>	_____	<u>Cmt. Ret. Noted</u> <sup>5-20</sup>
LONG STR:	Howco Lite <sup>5-20</sup>	<u>200</u> <sup>5-20</sup>	<u>1.54</u> <sup>5-32</sup>	<u>Surface</u> <sup>5-20</sup>	<u>at Surf.</u> <sup>5-20</sup>

INITIAL COMPLETION STIMULATION:

DATE: No initial stimulation required.

Description (type, pressure, volume, etc.): Not Applicable

Effect on injection and confining intervals:

Not Applicable

Subsequent Well Stimulations:

(Please provide the following for each stimulation)

DATE: No acidizations have been performed on this well.

Description (Type, pressure, volume, etc.): Not Applicable

Effect on injection and confining intervals:

No acidizations were performed on this well. Not Applicable

CONE OF INFLUENCE FOR UPPER MIocene SAND  
YEAR 1987 HISTORICAL INJECTION RATES

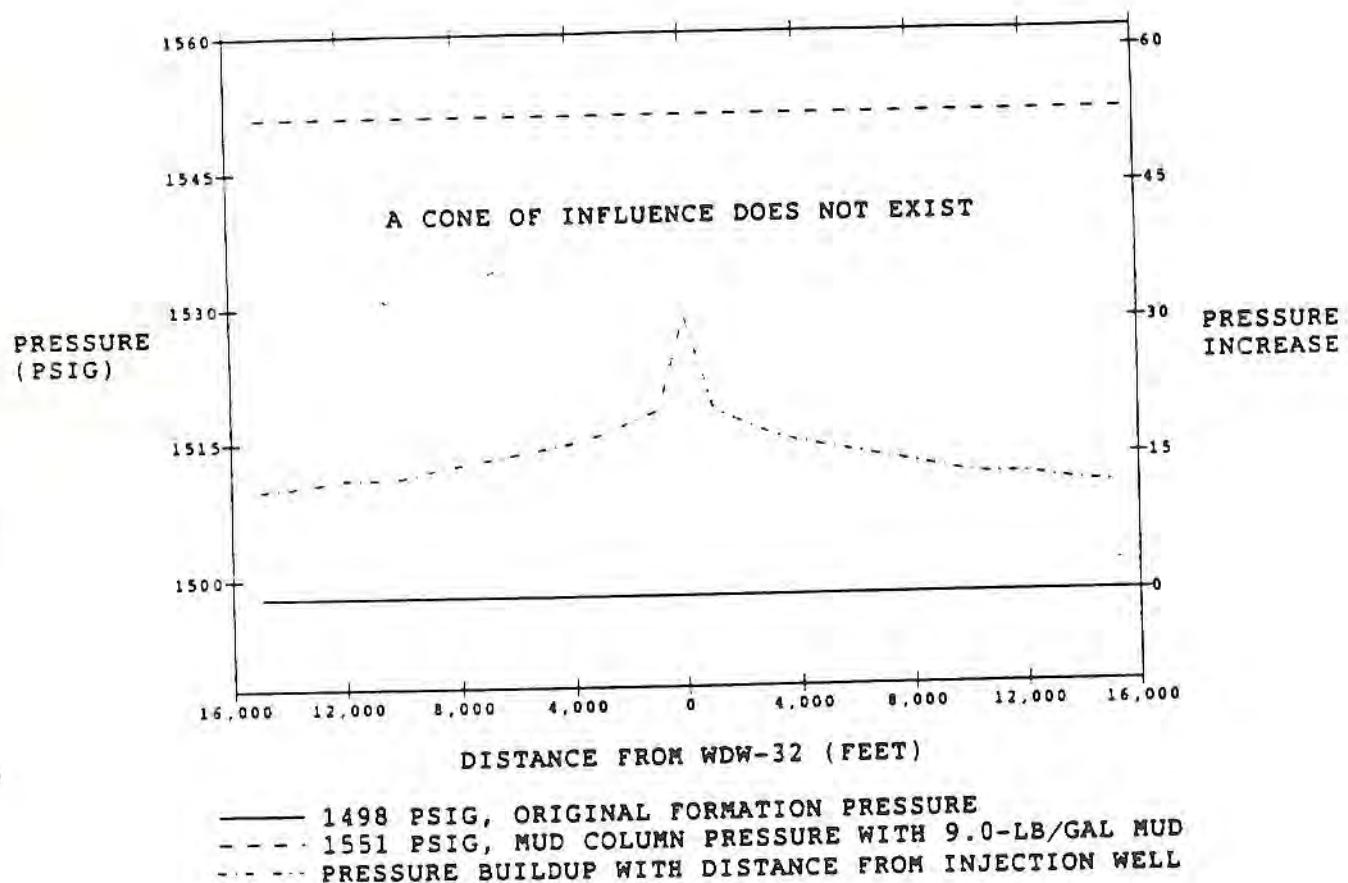


Figure 4-5  
Graph of Cone of Influence for Upper Miocene  
Injection Interval, Year 1987, Historical Injection Rates USED

4-14

M. J. Scott

CONE OF INFLUENCE FOR LOWER MIocene SAND  
YEAR 1987 HISTORICAL INJECTION RATES

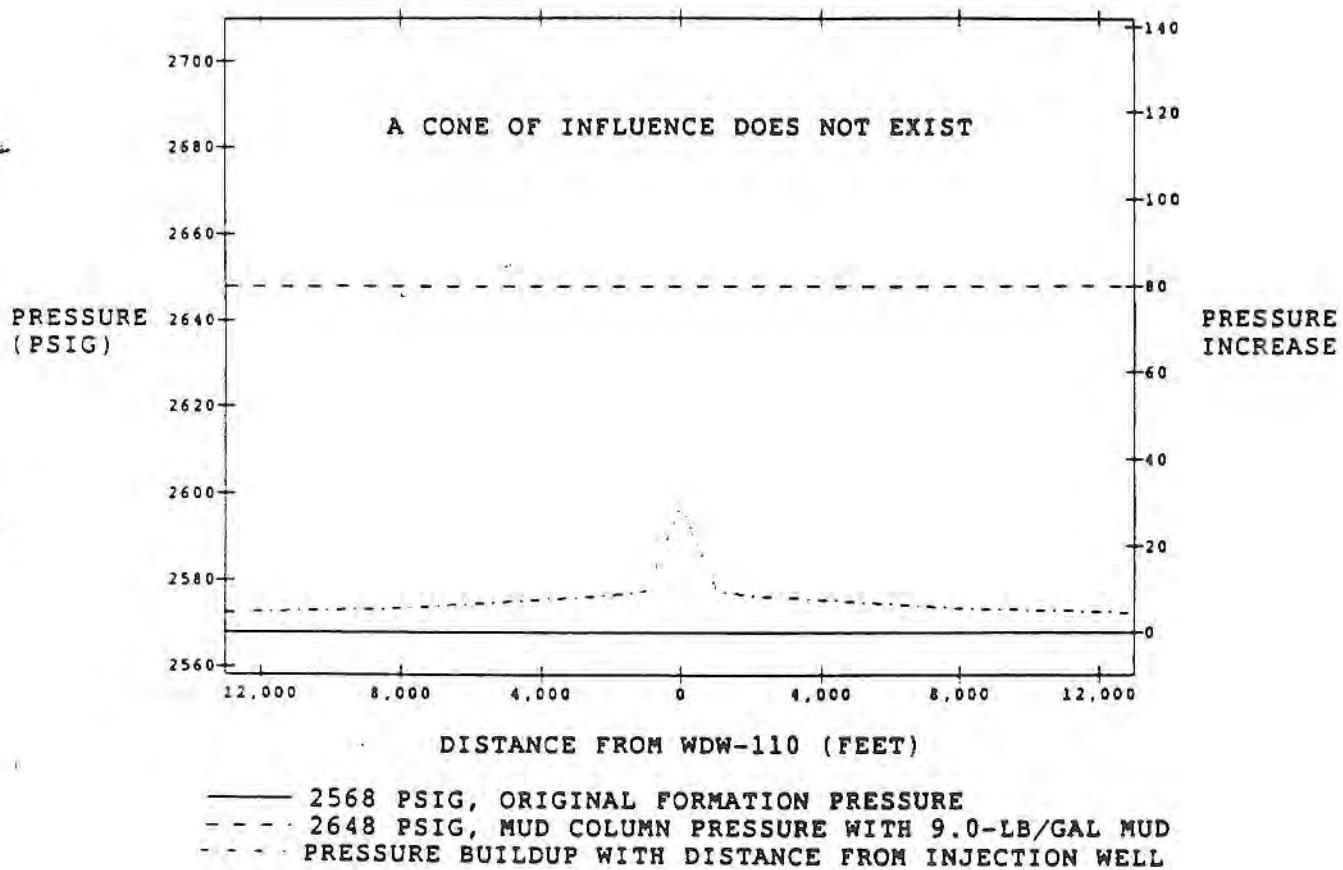


Figure 4-6  
Graph of Cone of Influence for Lower Miocene  
Injection Interval, Year 1987, Historical Injection Rates

4-15

MAY 17 1989

CONE OF INFLUENCE FOR UPPER MIocene SAND  
YEAR 2000 MAXIMUM PERMITTED INJECTION RATE

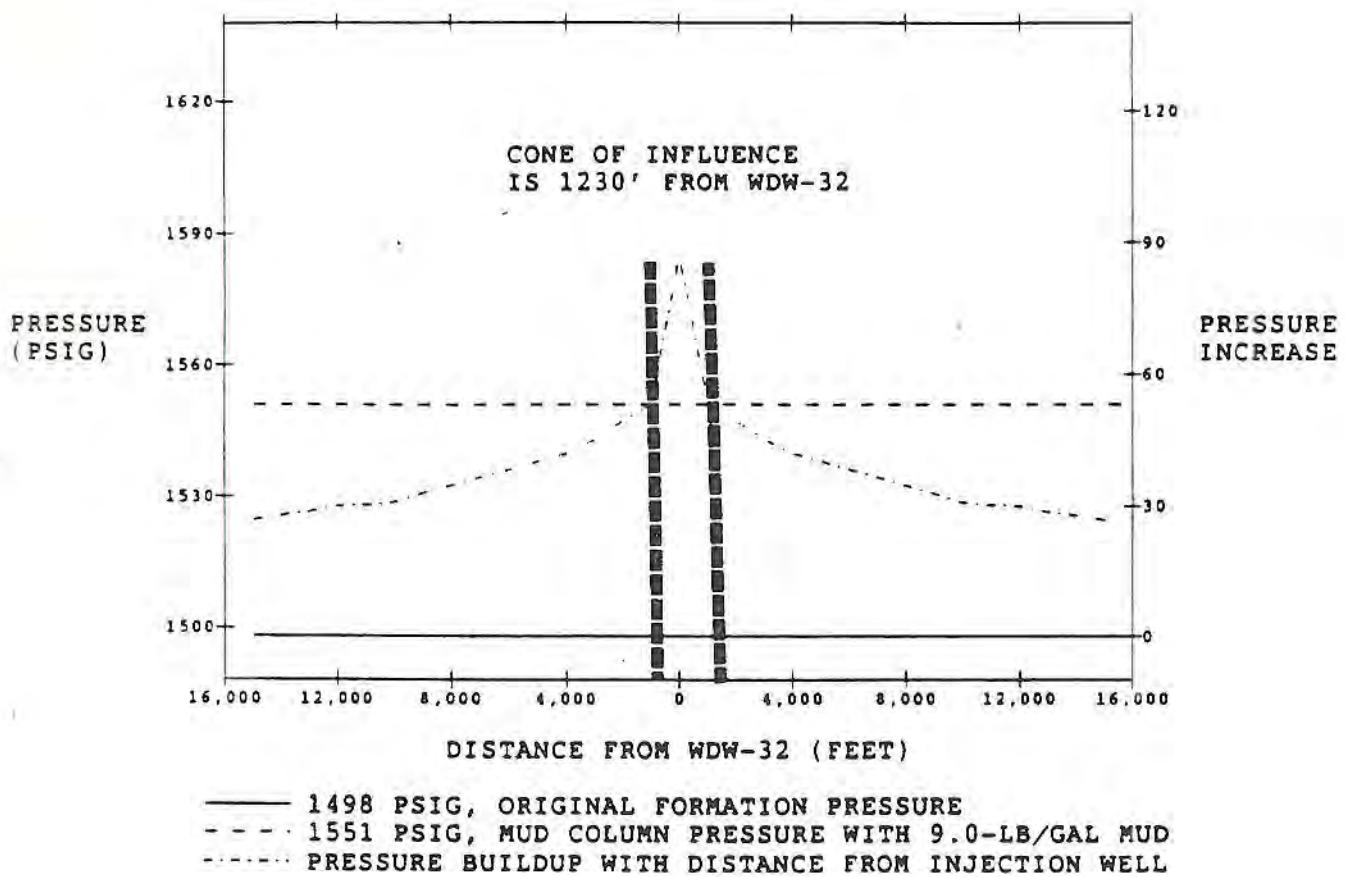


Figure 4-7  
Graph of Cone of Influence for Upper Miocene  
Injection Interval, Year 2000, Maximum Predicted Injection Rate  
PAGE REVISED  
4-16

MAY 1, 1988

CONE OF INFLUENCE FOR LOWER MIocene SAND  
YEAR 2000 MAXIMUM PERMITTED INJECTION RATE

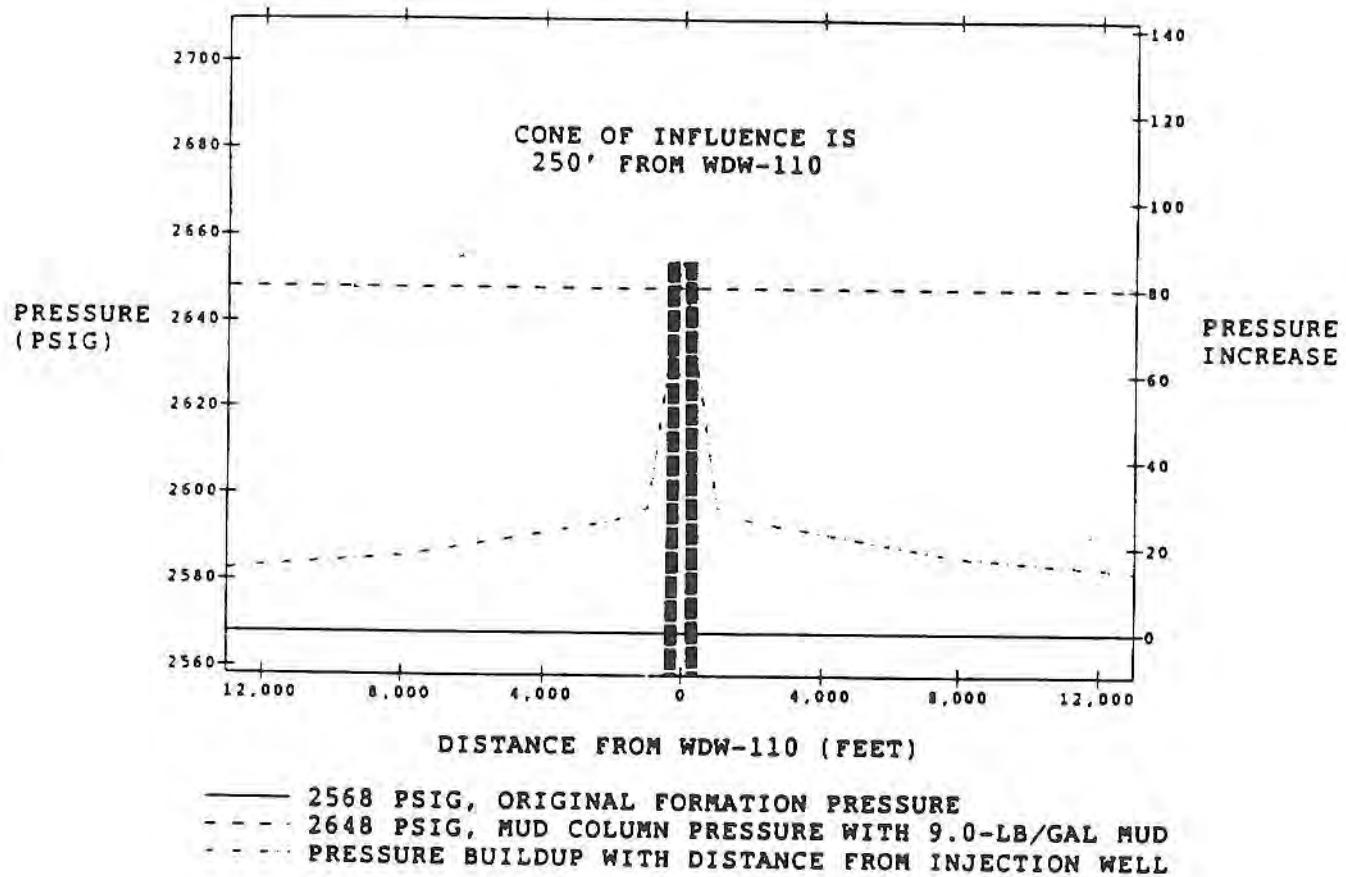


Figure 4-8  
Graph of Cone of Influence for Lower Miocene  
Injection Interval, Year 2000, Maximum Predicted PAGE REVISED Injection Rate

**ARTIFICIAL PENETRATION REVIEW**  
**ABANDONED WELLS**

MAP ID	WELL IDENTIFICATION ABSTRACT/ SECTION	DRILLING AND COMPLETION DATA			WELL STATUS		
		DATE DRILLED	DATE PLUGGED	TOTAL DEPTH	NON ENDANGERMENT STANDARD	PLUGGED PROPERLY NO	MIGRATION STANDARD*
1	A-17	United North and South Development Company L. V. Stoddard #8	Never Drilled			No*	
2	A-62	Van Dyke & Mejlaender Hamilton Savage #1	10/60	10,302'		No	
3	A-62	North American Royalties, Inc. W. Fondren #1	10/80	10,314'		Yes	No
4	A-62	Van Dyke & Mejlaender Walter W. Fondren #1-A	7/60	7/60	10,315'	Yes	
5	A-62	J. S. Michael Buckner Orphans Home #1	12/53	12/53	9,512'	Yes	No*
6	A-62 PA OC	Superior Oil Co. Fondren Estate #1	5/64	5/64	13,000'	Yes	No
7	A-16	Tenneco Oil Tom J. Petrucha #2	5/64	5/64	9,875	Yes	No*

MAP ID	ABSTRACT/ SECTION	WELL NO.	WELL IDENTIFICATION			DRILLING AND COMPLETION DATA			WELL STATUS		
			OPERATOR, LEASE	DATE DRILLED	DATE PLUGGED	TOTAL DEPTH	NON ENDANGERMENT STANDARD	PLUGGED PROPERLY NO MIGRATION STANDARD			
8	A-104	Tidewater Oil Co. B. E. Simon Unit #1	5/64	4/65		12,012'	Yes	No			
9	A-62	British American Oil Producing Co. Buckner Orphans Home #1	11/54	4/55		11,311'	No	No			
10	A-62	Superior Oil Co. Celanese Corp. #1	9/64	10/64		10,250'	Yes	No			
11	A-62	Stanolind Oil & Gas Buckner Orphans Home #1	7/42	8/42		11,365'	No	No			
12	A-17	Sun Exploration and Prod. Co. Union Carbide Corp. #1	4/84	2/85		12,500'	Yes	No			
13	A-17	Sun Exploration and Prod. Co. Union Carbide Corp. #1	2/84	2/85		12,265'	Yes	No			
14	A-18	Sinclair Oil & Gas Company J. C. Lewis #1	5/60	5/62		11,964'	Yes	No*			

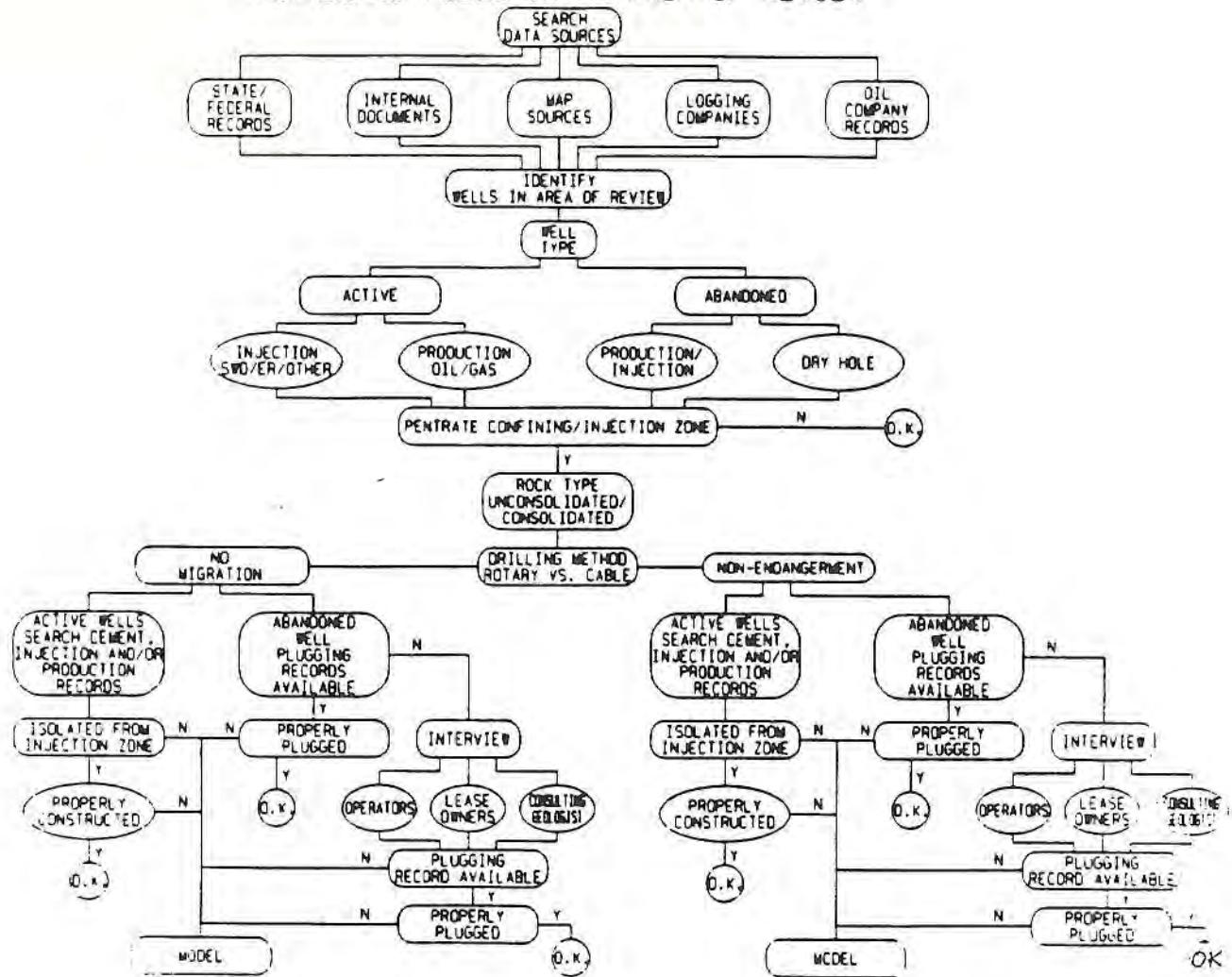
MAP ID	ABSTR. SECTION	WELL IDENTIFICATION		DRILLING AND COMPLETION DATA		WELL STATUS	
		OPERATOR, LEASE WELL NO.	DATE DRILLED	DATE PLUGGED	TOTAL DEPTH	NON ENDANGERMENT STANDARD	PLUGGED PROPERLY NO
15	A-18	Humble Oil & Refining Company J. C. Lewis #1	12/62	12/62	11,700'	No	No
16	A-17	Caroline Hunt Trust Estate J. C. Lewis #1	2/57	2/57	9,700'	Yes	No
17	A-17	Adobe Oil & Gas Corp. Dawdy #1	3/83	12/86	13,100'	Yes	No
18	A-17	Davis Oil Co. & Terra Resources James D. Wendt #1	12/75	12/76	11,020'	Yes	No
19	A-90	Continental Oil Co. W. W. Fondren Jr. #1	3/65	4/69	13,520'	Yes	No
20	A-90	United North and South Development Co. Buckner Orphans Home #1	9/44	9/44	8,514'	No	No
21	A-17	Riseden LTD H. R. Dawdy #1	7/85	7/85	8,266'	No	No
22	A-17	Texkan Oil Co. R. A. Wendt #1	11/62	12/62	11,011'	Yes	No

MAP ID	ABSTRACT/ SECTION	WELL IDENTIFICATION	DRILLING AND COMPLETION DATA			WELL STATUS		
			OPERATOR, LEASE WELL NO.	DATE DRILLED	DATE PLUGGED	TOTAL DEPTH	NON ENDANGERMENT STANDARD	PLUGGED PROPERLY NO MIGRATION STANDARD
23	A-17	United North and South Development Co. R. A. Wendt #1	3/43	12/52	8,192'	No	No	No*
24	A-17	United North and South Development Co. L. V. Stoddard #7	12/42	12/52	8,598'	No	No	No*
25	A-17	United North and South Development Co. L. V. Stoddard #10	10/43	10/43	9,311'	No	No	No*
26	A-55	United North and South Development Co. Buckeye Farm Unit 25 #1	1/34	1/34	8,500'	No	No	No*
27	A-17	United North and South Development Co. L. V. Stoddard #9	5/43	5/43	9,311'	Yes	Yes	No*
28	A-55	United North and South Development Co. Dawdy #1	11/43	NA	8,637'	No	No	No*
29	A-16	Phillips Petroleum Co. Pierce #1	11/54	11/54	12,505'	Yes	Yes	No*

MAP ID	ABSTRACT/ SECTION	WELL IDENTIFICATION				DRILLING AND COMPLETION DATA				WELL STATUS			
		OPERATOR, LEASE WELL NO.	DATE DRILLED	DATE PLUGGED	TOTAL DEPTH	NON ENDANGERMENT STANDARD	NO MIGRATION STANDARD	PLUGGED PROPERLY	NO MIGRATION STANDARD	NON ENDANGERMENT STANDARD	NO MIGRATION STANDARD	NON ENDANGERMENT STANDARD	NO MIGRATION STANDARD
30	A-104	Mobil Oil Corp. Tom J. Petrucha #1	10/65	4/67	13,102'	Yes	No						
31	A-90	The Texas Co. Buckner Orphans Home #1	11/52	11/52	11,559'	No	No*						
32	A-62	Diamex Co. Eva Savage #1	1/81	1/81	10,365'	Yes	No*						

\* Will not come into contact with waste plume now or in future

**PROTOCOL FOR IDENTIFYING  
ABANDONED WELLS IN AN AREA OF REVIEW**



**Figure 1 Area of Review Protocol**

**APPENDIX 4-7**  
**ADDITIONAL MODELING DATA TABLES**  
**UPPER MIocene INJECTION INTERVAL**  
**HOECHST CELANESE CHEMICAL GROUP, INC., BAY CITY PLANT**

**ARTIFICIAL PENETRATION**  
**UPPER MIocene INJECTION INTERVAL DATA**

ID	TD	II DEPTH	ACTUAL MUD WT.	PRES W/ COL 4	PRES W/ 9 LB/GAL	ORI FORM PRESSURE	ALLOW. BUILDUP
2	10302	3420	11.0	1956	1601	1546	55
9	11311	3333	10.1	1751	1560	1507	53
10	10250	3349	11.1	1933	1567	1514	53
11	11365	3348	9.8	1706	1567	1513	54
15	11700	3315	12.2	2103	1551	1498	53
20	8514	3375	9.7	1702	1580	1526	54
21	8266	3371	10.0	1753	1578	1524	54
23	8192	3367	9.8	1716	1576	1522	54
24	8598	3394	9.9	1747	1588	1534	54
25	9311	3399	9.8	1732	1591	1536	55
26	7970	3412			1597	1542	55
28	8637	3400	9.7	1715	1591	1537	54
31	11559	3422	9.8	1744	1601	1547	54

Column Headings:

1. ID = artificial penetration number
2. TD = total depth (feet)
3. II DEPTH = injection interval depth below ground level (feet)
4. ACTUAL MUD WT. = mud weight (lb/gal) of mud being modeled (see Section 4.6)
5. PRES W/ COL 4 = pressure of static mud column (psi) using actual mud weight (Column 4) with no gel strength
6. PRES W/ 9 LB/GAL = pressure of static column (psi) using 9.0-lb/gal mud and no gel strength
7. ORI FORM PRESSURE = original formation pressure (psig)
8. ALLOW. BUILDUP = static mud column of 9.0-lb/gal mud (psi) only - original formation pressure (=Column 6 - Column 7)

**APPENDIX 4-7**  
**ADDITIONAL MODELING DATA TABLES**  
**LOWER MIocene INJECTION INTERVAL**  
**HOECHST CELANESE CHEMICAL GROUP, INC., BAY CITY PLANT**

**ARTIFICIAL PENETRATION**  
**LOWER MIocene INJECTION INTERVAL DATA**

ID	TD	II DEPTH	ACTUAL MUD WT.	PRES W/ COL 4	PRES W/ 9 LB/GAL	ORI FORM PRESSURE	ALLOW. BUILDUP
2	10302	5762	11.0	3296	2697	2616	81
9	11311	5675	10.1	2981	2656	2577	79
10	10250	5691	11.1	3285	2663	2584	79
11	11365	5690	9.8	2900	2663	2583	80
15	11700	5657	12.2	3589	2648	2568	80
20	8514	5717	9.7	2884	2676	2596	80
21	8266	5713	10.0	2971	2674	2594	80
23	8192	5709	9.8	2909	2672	2592	80
24	8598	5736	9.9	2953	2684	2604	80
25	9311	5741	9.8	2926	2687	2606	81
26	7970	5754			2693	2612	81
28	8637	5742	9.7	2896	2687	2607	80
31	11559	5764	9.8	2937	2698	2617	81

Column Headings:

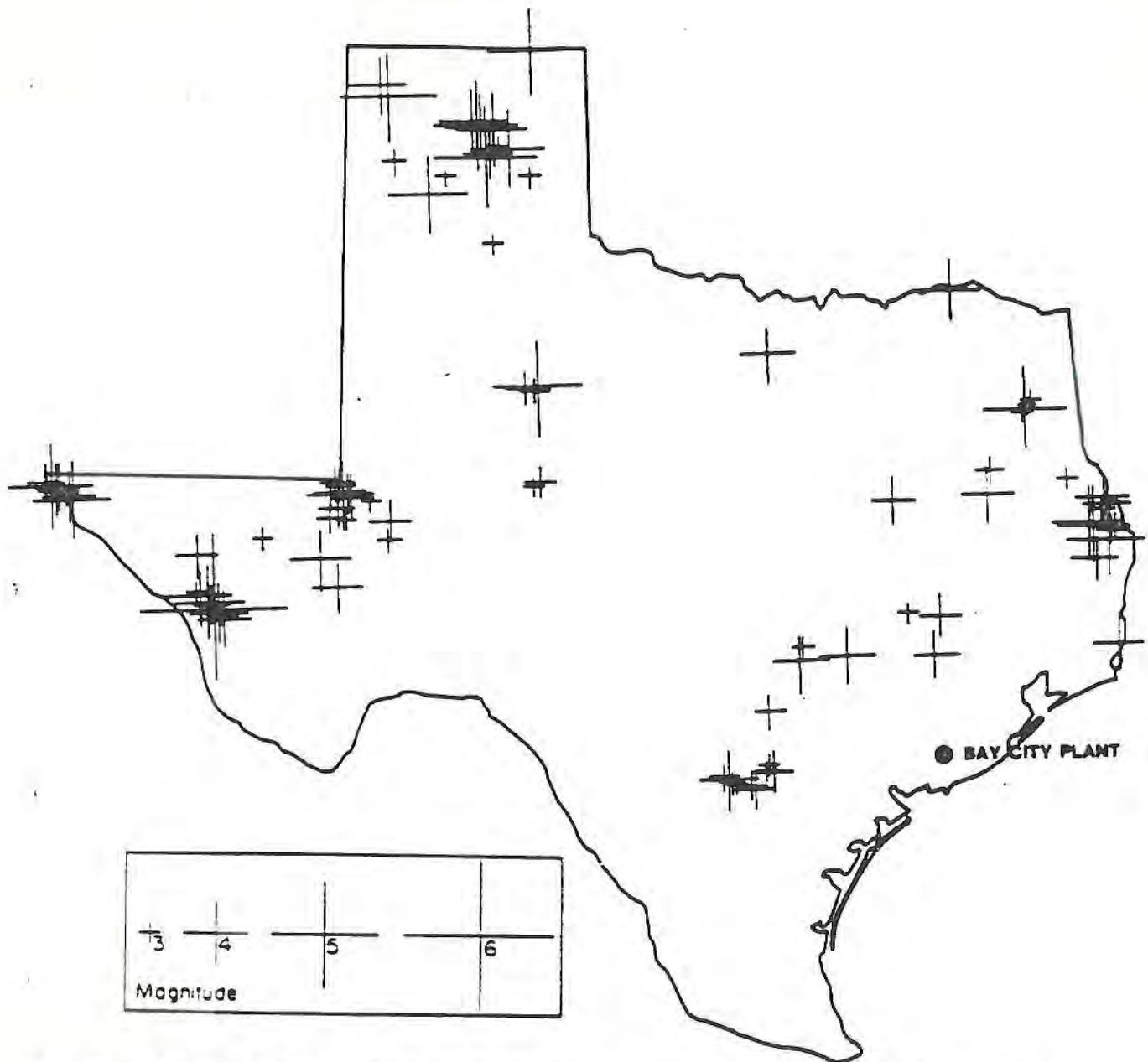
1. ID = artificial penetration number
2. TD = total depth (feet)
3. II DEPTH = injection interval depth below ground level (feet)
4. ACTUAL MUD WT. = mud weight (lb/gal) of mud being modeled (see Section 4.6)
5. PRES W/ COL 4 = pressure of static mud column (psi) using actual mud weight (Column 4) with no gel strength
6. PRES W/ 9 LB/GAL = pressure of static column (psi) using 9.0-lb/gal mud and no gel strength
7. ORI FORM PRESSURE = original formation pressure (psig)
8. ALLOW. BUILDUP = static mud column of 9.0-lb/gal mud (psi) only - original formation pressure (=Column 6 - Column 7)



Figure 3-2  
Structure Contour Map on the Top of the Frio Formation (modified from Galloway (1981))  
Hoechst Celanese Chemical Group, Inc., Bay City Plant



Figure 6-3  
Seismic Risk Map of the United States  
Hoechst Celanese Chemical Group, Inc., Bay City Plant



THE EARTHQUAKE MAGNITUDES ON THIS MAP ARE EXPLAINED ON PAGE 40 OF REFERENCE 7 WHICH IS CONTAINED IN THE SELECTED PETITION REFERENCES VOLUME. THE MAGNITUDES ON THIS MAP ARE NOT STANDARD RICHTER/MERCALI SCALE VALUES (ALTHOUGH MERCALI INTENSITIES ARE GIVEN IN REFERENCE 7 FOR EACH EVENT). A TABLE OF MERCALI INTENSITIES IS ALSO PROVIDED AFTER REFERENCE 7.

Figure 3-4  
Earthquake Epicenters and Magnitudes in the State of Texas  
1847 to Present (modified from Davis, et al [7])  
Hoechst Celanese Chemical Group, Inc., Bay City Plant

PAGE R - CED  
APR 04 1989  
MAY 17 1989

Depths Are Approximate Measured  
Log Depths Taken From The Map ID  
→ 9 Petition Type Log

PERIOD	STAGE OR GROUP	FORMATION	ENVIRONMENT OF DEPOSITION / LITHOLOGY
QUATERNARY	HOLOCENE	UNDIFFERENTIATED	Fluvial deposits. Medium bedded sandstones, conglomerates and shales.
	12,000 yrs HOUSTON L.WISCONSIN	BEAUMONT	
	WISCONSIN E.WISCONSIN		
	BANGAMON L.ILLINOIAN		Fluvial and deltaic deposits.
	PRE-BANGAMON E.ILLINOIAN	LISBIE	
	YARMOUTH KANSAN		Medium bedded sandstones and shales.
	2.6 MYBP AFTONIAN NEBRASKAN	WILLIS	
PLIOCENE	CITRONELLE GROUP	GOLIAD	Fluvial, deltaic and marginal marine deposits. Medium to thinly bedded sandstones and shales.
	5.3 MYBP		
MIocene	FLEMING GROUP	LAGARTO	Predelta, delta front and delta depositional deposits. Medium to thinly bedded sandstones and shales.
		OAKVILLE	Channel, meanderbelt and crevace splay deposits. Medium bedded sandstones and shales.
	24 MYBP		
TERTIARY	CATAHOULA GROUP	ANAHUAC	Outer shelf and slope deposits. Massive shale with basal sandstone and localized limestones (Hot Limestones).
OLIGOCENE		PRIOR	Aggradational shoreface and beach deposits. Massively bedded sandstones and shales.
	VICKSBURG GROUP	VICKSBURG	Deltaic, outer shelf and slope deposits. Massively bedded shales and medium bedded sandstones.
37 MYBP			



Figure 3-1  
Stratigraphic Column for the Bay City Plant  
Hoechst Celanese Chemical Group, Inc., Bay City Plant

# Appendix 1

## 6.2 OPERATIONS HISTORY

### 6.2.1 WDW-14 (Well 2)

Following is a summary and chronology of the maintenance, repair work, and mechanical integrity testing that have been performed on the Bay City Plant WDW-14. All reported depths are referenced from the Kelly Bushing elevation of 42.5 feet above mean sea level unless otherwise noted.

#### 6.2.1.1 Summary of Operations (WDW-14)

The drilling of WDW-14 commenced on December 26, 1964, and all drilling, testing, logging, and cementing was completed on January 3, 1965. The well was drilled to a total depth of 3,780 feet and was completed in the upper Miocene. Injection operations commenced on April 3, 1965.

The original casing design for WDW-14 consisted of surface casing (13 3/8-inch, 48-lb/ft, H-40) set and cemented to 1,369 feet. The protective casing (9 5/8-inch, 40-lb/ft, J-55) casing was set and cemented to 3,750 feet. Waste injection was originally through 2 3/8-inch injection tubing and perforations from 3,516 feet to 3,546 feet [15].

In December of 1968, the well was perforated from 3,520 feet to 3,550 feet in order to increase the well's injection flow rate. In October 1969, the 2 3/8-inch injection tubing was replaced with 5 1/2-inch tubing. The well was perforated again from 3,450 feet to 3,520 feet in September 1974.

In February 1975, the well began to experience difficulties with the packer becoming unseated due to the injection of cold waste. As a

short term solution, the waste was steam heated and no further leakage was observed. In April of 1976, the packer was replaced with a stainless steel packer and a six foot seal assembly was installed to compensate for tubing contraction.

Due to decreased injection capacity, the well was additionally perforated from 3,450 feet to 3,520 feet in January 1980, giving a current injection interval open to fluid flow of 3,450 feet to 3,550 feet. In February 1987, new 5 1/2-inch injection tubing was installed.

#### 6.2.1.2 Workover History (WDW-14)

November 13, 1967

The well was cleaned out to remove sand fill which partially covered the perforations. Three joints of the 2 3/8-inch tubing were removed for corrosion examination [16].

December 5 to December 10, 1968

Two acid stimulations had been performed the previous month in an effort to increase the injection rate. The injection tubing was pulled and found to have some corrosion and scale developed. The well was washed to 3,660 feet, additionally perforated from 3,520 feet to 3,550 feet, and acidized with ferric acid. After hydrajetting, the well was returned to service with normal readings [17].

September 29 to October 6, 1969

WDW-14 was worked over to remove sand fill. A casing inspection log was run from 1,350 feet to 3,537 feet and a caliper log was run from

the surface to 1,500 feet. The sand was bailed out of the well, and stainless steel packer and 5 1/2-inch injection tubing were run. The packer was set at 3,208 feet and pressure tested with 200 psi. The injection tubing was tested to 700 psi. A caliper log was run on the 5 1/2-inch injection tubing [18].

November 2, 1970

The well was hydrajetted in order to increase injection flow rate.

April 1972

A caliper log indicated some corrosion on the 5 1/2-inch injection tubing. The tubing was removed, inspected, and sand blasted. A casing caliper log was run on the 9 5/8-inch casing from the surface to 3,161 feet. The 5 1/2-inch injection tubing was run back in the well with five new joints of tubing and a seal assembly. Baroid Coat B 1400 inhibitor was added to the annulus fluid and the injection tubing and seal assembly were set in the packer at 3,208 feet. The well was returned to service [19].

February 4 to February 7, 1974

Sand fill was cleaned out of WDW-14 in an attempt to increase flow. The cleaning procedure was not successful in increasing the flow [20].

August 22, 1974

A temperature survey was run from the surface to 3,630 feet. The bottom hole temperature (BHT) was 116.5° F [21].

September 11, 1974

WDW-14 was additionally perforated from 3,450 feet to 3,520 feet in order to increase the flow rate of the injected waste. The well was placed back on line [21].

February 7, 1975

An annulus leak was detected and the well was immediately shut-in. The cause of the leak was found to be the unseating of the packer due to injection of abnormally cold waste. After thermal equilibrium was reached, the packer reseated itself and was pressure tested to 400 psi with no leakage detected. A steam heating system was installed to heat the waste in order to prevent a recurrence of the event [22].

August 18 to August 28, 1975

In order to provide a long term solution to the unseating of the packer due to injection of cold waste, a rig was brought in to place more weight on the packer. However, it was discovered that most of the injection tubing weight was already on the packer. No further weight was added to the packer to avoid possible mechanical damage. The well was started up and the heating of the waste stream by steam was continued [23].

January 10 to January 13, 1976

The packer once again became unseated due to the injection of cold waste. The well was shut-in and the packer reseated itself once thermal equilibrium of the waste was reached. The well was restarted with steam heated waste with an annulus pressure higher than the injection pressure. No further leakage was observed.

March 30 to April 24, 1976

The well was shut down to replace the packer and install a six foot seal assembly to compensate for tubing contraction caused by the injection of cold waste. An annulus leak occurs when the packer seal is lost due to tubing contraction.

The 5 1/2-inch injection tubing was removed and inspected. The top joint showed significant corrosion, but the remainder of the tubing was in fair condition. Approximately 1/8-inch of soft scale had been deposited on the inside of the tubing.

The old packer was removed from the well and a new stainless steel packer was set. The new packer was set at 3,162 feet and tested at 500 psi. A six foot seal assembly was set on the cleaned out tubing. The tubing was then tested to 1500 psi. The annulus was pressure tested with 300 psi for 12 hours. The well was returned to service [24].

May 19, 1976

An annulus leak was detected. An investigation indicated that the leak was between the 9 5/8-inch casing and the outside sealing area of the packer.

May 24 to May 26, 1976

A rig was brought in and all of the tubing weight was added to the packer in order to compress the Teflon seal ring between the 9 5/8-inch casing and the outside sealing area of the packer. The annulus was pressured up to 1400 psi. After 11 hours the pressure had bled off 6% due to a leak in the rubber wellhead seal and a temperature change [24].

January 5, 1977

The packer on WDW-14 was leaking, apparently due to the injected waste being approximately 40° F cooler than normal. The annulus was pressure tested at 538 psig and no leak was detected. Prior to putting the well back in service a steam sparger in the effluent sump was activated to insure the effluent temperature was close to normal. The well was placed back in service without any indication of leakage [25].

January 30 to April 1, 1980

The injection capacity of WDW-14 had declined over the past several years and on August 14, 1979 a wireline bailer recovered a sample of organic sludge from the well. The well was then worked over to increase its capacity.

The casing was additionally perforated from 3,450 feet to 3,520 feet and was returned to service at a rate of 150 gpm at 630 psi. The well was shut-in, jetted with nitrogen, and acidized. A static BHP of 1,535 psig was measured at a depth of 3,400 feet and an injection BHP was 2,031 psig at 145 gpm.

The injection pressure was 600 psi at 140 gpm. The injection interval was acidized again and additionally perforated from 3,354 feet to 3,414 feet. The well was again jetted with nitrogen and returned to service at a rate of 320 gpm at 455 psig [26].

November 29 to December 1, 1983

A mechanical integrity test (MIT) was conducted on WDW-14. The annulus was pressure tested and a radioactive tracer survey (RTS) was run. These tests demonstrated the mechanical integrity of the well as required by Texas regulation 31 TAC § 353.15 [27].

February 17 to March 1, 1987

WDW-14 was worked over due to a loss of annulus pressure. The 5 1/2-inch injection tubing was removed from the well. A visual inspection of the tubing revealed a scale coating 3/8-inch to 1-inch thick on its interior. A casing inspection log was run and showed moderate pitting to the 9 5/8-inch casing. It is probable this pitting was caused by waste which entered the annular space when the packer became unseated. A RTS was run and no indication of upward migration of fluids surrounding the wellbore was observed.

The 9 5/8-inch casing and the packer were pressure tested to 770 psig for 30 minutes. New 5 1/2-inch injection tubing, wellhead, and a redressed seal assembly were installed on the well. The annulus was filled with a corrosion inhibited brine. The annulus was pressure tested to 770 psig for 30 minutes. The pressure decreased to 752 psig which was within the 5% maximum allowable set by the Texas Water Commission (TWC) and the well was returned to service [28].

November, 1988

Mechanical integrity was demonstrated on WDW-14 by using an annulus pressure test, temperature survey, bottom hole pressure fall-off survey, and RAT. Also, the bottom hole pressure (BHP) and bottom hole temperature (BHT) were recorded as 1441.25 psia and 98.7°F at 3150 feet.

The MIT began with an annulus pressure test of 800 psig for 44 minutes. The pressure bleed off was 7 psi (0.8%) at the end of the test. Because the leak-off was less than 5% after 30 minutes, the integrity of the casing was demonstrated. A temperature log was then run from the surface to 3477 feet (PBTD). A slight temperature drop was noted from 400 feet to 470 feet. This was caused by the production of fresh water for plant use. The log also indicated temperature anomalies from 3270 feet to 3420 feet which were almost certainly due to injection operations of WDW-32. Other temperature

) anomalies in the well were normal when compared to other wells in the area. A radioactive tracer survey was then run showing that all injected fluid moved down the tubing and into the injection interval. Also, the RAT survey revealed the leak-free condition of the tubing, casing strings, and packer within the test interval. This test demonstrated that there was no migration of injected fluid above the injected zone. Upon demonstration of mechanical integrity, the well was put back in service (see Golden StrataServices, Inc. Mechanical Integrity Test Report submitted with this petition [42]).

## 6.2.2 WDW-32 (Well 3)

Following is a summary and chronology of the maintenance, repair work, and mechanical integrity testing that has been performed on the Bay City Plant WDW-32. All reported depths are referenced from the Kelly Bushing elevation of 42.5 feet above mean sea level unless otherwise stated.

### 6.2.2.1 Summary of Operations (WDW-32)

The drilling of WDW-32 began in June 1967, and was drilled to a total depth of 3,710 feet into the upper Miocene formation. Drilling was completed on July 4, 1967. The well was first used for injection on July 22, 1967.

The original casing design for WDW-32 consists of 1,302 feet of surface casing (13 3/8-inch, 48-lb/ft, H-40) cemented to the surface with 500 sacks of Trinity Lite Ware and 300 sacks of common cement. The protective casing (9 5/8-inch, 40-lb/ft, J-55) was then set to 3,245 feet and cemented to the surface with 100 sacks of common and 1,002 sacks of 50/50 Pozmix cement. Waste water was first injected into the carbon steel tubing (5 1/2-inch, 20-lb/ft, N-80) with a slotted screen from 3,317 feet to 3,493 feet.

In November 1967, eighty perforations were shot from 3,434 feet to 3,454 feet to increase well flow. In May of 1969, the well was sidetracked by putting a cast iron plug in the original hole at 3,306 feet and milling out the protective casing between 3,245 feet and 3,275 feet. The sidetracked hole was drilled to 3,553 feet and the screen was set from 3,315 feet to 3,553 feet into the upper Miocene injection sand.

An annulus leak was detected in February, 1975 and the 9-inch seal bore packer was replaced by a 6-foot seal bore packer. The packer was then replaced in October, 1986 along with the injection tubing and the wellhead.

#### 6.2.2.2 Workover History (WDW-32)

July 21 to July 26, 1967

Ten feet of 2-inch tubing (attached above 5.2 feet of workover tools) was lost in the hole. In addition, a bond log indicated a less than complete cement bonding in the lower portion of the hole. The interval above the fish (from 3,346 feet to 3,347) feet was perforated and the original injection interval was cemented off through these perforations. The fish was left in the hole. The tubing failure and the loss of the fish in the hole was determined to be the result of a bad joint of pipe [29].

November 1 to November 10, 1967

To increase well flow, 80 perforations were shot from 3,434 feet to 3,454 feet. The well also was jetted and gravel packed. A four inch screen and liner was added adjacent to the perforations [30].

December 11 to December 14, 1968

Due to declining effluent flow rate, the well was shut down and the tubing was pulled. Upon inspection of the tubing, there was no appreciable corrosion present, but a fill at 3,335 feet (in tell-tale section) was present. The well was jetted and put back in service [31].

January 24, 1968 to March 27, 1969

The well was jetted twice and washed twice in an attempt to increase injection rate. The well was also acidized with 2 thousand gallons of hydrochloric acid (HCl) [30].

May 17 to June 4, 1969

To increase the injection rate, the well was sidetracked by putting a cast iron plug in the original hole at 3,306 feet and milling out the 9 5/8-inch casing between 3,245 feet and 3,275 feet. A 4 1/2-inch diameter stainless steel screen and liner section was put in the new hole from 3,202 feet to 3,553 feet and a new 5 1/2-inch injection casing was run from the surface to 3,202 feet [30]. The well was then jetted and put back in service.

December 10, 1970

The annulus on WDW-32 was observed to be flowing intermittently due to the unseating of the injection stringer from the packer. The stringer was reseated at a point 6" below the original setting point. The well was pressure tested to 1,000 psig for 50 minutes, a new pup joint was added, and the well was put back into service [32].

February 6, 1974

A pressure test was run with WDW-14, WDW-32, WDW-49 shut-in. WDW-49 was then started up at 200 gpm followed by WDW-14 at 325 gpm. The test gave satisfactory results and the well was put back in service [33].

August 20, 1974

A temperature survey was run from 3.000 feet to 3.460 feet showing the effluent entering the formation at the permitted interval. The survey was rerun showing the same results and the well was put back on line [34].

August 30, 1974

Cleaned well with NOWSCO tubing unit to increase injection flow rate. Spinner survey showed all flow to be passing through the top portion of the screen. A temperature survey was also run showing no effluent leaking up the casing and that all the effluent was going into the injection interval [22].

August 21 to August 27, 1975

Pulled old packer (containing 9-inch seal bore) and installed new packer with a 6-foot seal bore to adequately compensate for any stringer contraction and prevent losing the packer seal due to injection of cold effluent [30].

November 29 to December 1, 1983

A mechanical integrity test (MIT) was conducted on WDW-32. The annulus was pressure tested and a radioactive tracer survey (RTS) was run. These tests demonstrated the mechanical integrity of the well as required by Texas regulation 31 TAC § 353.15 [27].

August 6 to August 15, 1986

Due to loss of annular pressure the well was shut-in for repairs. The results of an acoustic caliper log revealed that the overshot was not in contact with the polished riser of the screen as it should be. Upon pulling the injection string, corrosion was noted in the base of its pin connections and three pin joints were determined to have possible leaks.

An electromagnetic thickness log was run to evaluate the casing thickness. The well was then reassembled with a six foot stainless steel assembly with Teflon seal units, 3.158 feet of injection tubing (5 1/2-inch, 20-lb/ft, N-80), and a new wellhead was installed (Larkin type "SR" tubing hanger). The annulus pressure test was performed with 996 psig for thirty minutes with a 6 psig pressure drop [35]. This is well within the 5 % allowable pressure drop under the Texas Water Commission regulations, and the well was put back in service.

December 30, 1987

An annular pressure test was conducted on WDW-32 to demonstrate mechanical integrity. The well held an annulus pressure of 1000 psi for thirty minutes with no pressure decrease.

June 9, 1988

Because of a reduction of flow in WDW-32, bottom hole samples were taken along with the bottom hole pressure under dynamic conditions. The sample, analyzed by Halliburton's laboratory, contained high concentrations of amorphous organics with more than 50% of the particles smaller than 10 microns. Also, solubility tests that were run on the samples indicate that 45.1% of the bottom hole sample and 77.1% of the sample from the screen were soluble with a 28% solution of HCl. The well was then returned to service.

November, 1988

Mechanical integrity was demonstrated on WDW-32 by using an annulus pressure test, temperature survey, bottom hole pressure fall-off survey, and RAT. Also, the bottom hole pressure (BHP) and bottom hole temperature (BHT) were recorded as 1502.5 psia and 100.7°F at 3300 feet.

The MIT began by pressurizing the annulus to 1000 psig. The pressure stabilized and the leak-off after 30 minutes was 4 psi (996 psi to 992 psi) or 0.4%. Because the leak-off was less than 5% after 30 minutes, the integrity of the casing was demonstrated. A temperature log showed normal fluctuations through the surveyed interval. A radioactive tracer survey was then run showing that all injected fluid moved down the tubing and into the injection interval. It appeared that the fluid was moving below the bottom of the borehole and that there was no upward migration of injection fluid above the injection zone. Also, the RAT survey revealed the leak-free condition of the tubing, casing strings, and packer within the test interval. Upon demonstration of mechanical integrity, the well was put back in service (see Golden StrataServices, Inc. Mechanical Integrity Test Report submitted with this petition [42]).

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### 6.2.3 WDW-49 (Well 4)

Following is a summary and chronology of the maintenance, repair work and mechanical integrity testing done on the Bay City Plant WDW-49. All depths are referenced from the Kelly Bushing elevation of 43.5 feet above sea level unless otherwise noted.

#### 6.2.3.1 Summary of Operations (WDW-49)

The drilling of WDW-49 began on May 7, 1969 and was drilled to a total depth of 3,630 feet and completed in the upper Miocene section. The well was first used for injection on June 15, 1969.

The casing design for WDW-49 consists of 1,389 feet of surface casing (10 3/4-inch, 32.75-lb/ft., H-40) cemented to the surface with 525 sacks of Howco Lite and 200 sacks of common cement. The upper string of the protective casing (7 5/8-inch, 26.4-lb/ft., J-55) was set to 3,294 feet. The lower string (7 5/8-inch, 316 SS, Sch. 40) was set from 3,294 feet to 3,368 feet. This casing was cemented to the surface with 481 sacks of Lone Star Incorporated cement and 200 sacks of Howco Lite cement.

In November, 1970 the leak detection pot indicated that effluent was getting into the annulus. It was determined that the seal assembly was not seated in the packer. This was remedied and the well was put back in service.

In October 1974 the well was jetted in an effort to increase effluent injection flow rate. In October, 1977 the well was shocked by abruptly shutting down the injection pump and then restarting the pump, in order to restore flow rate.

In 1986 the well was shut down due to loss of annular pressure. The injection string, seal assembly, and wellhead were replaced and the

well was put back in service. Currently, the well is injecting through slots in the screen from 3,372 - 3,579, into the upper Miocene injection sand.

#### 6.2.3.2 Workover History (WDW-49)

November 24 to December 9, 1970

The leak detection pot indicated that effluent was getting into the annulus from the injection string. The annulus was filled with brine and pressured to prevent additional effluent from getting into annulus. It was found that the 5 1/2-inch injection string was not properly seated in the packer. An additional foot of injection tubing was put into the well and set on the packer with 30 thousand pounds to prevent further leakage [36].

August 20 to August 29, 1974

The well was jetted and chemically cleaned with a sodium hypochlorite and caustic mixture in an effort to increase effluent flow rate. A spinner survey showed most of the flow to be passing through the top portion of the screen. The survey also indicated screen damage. Absolute and differential temperature surveys were then run to determine the flow of the effluent. This log indicated no effluent leaking up casing and that all effluent was going into the permitted zone [37].

August 30, 1977

In order to restore injection flow rate, the well was shocked by abruptly shutting down the injection pump for approximately thirty seconds. The flow rate increased from 75 gpm to 120 gpm. The well was again shocked to further increase the flow rate to 195 gpm by shutting down the pump for approximately one minute [36].



of an active fresh water well at the plant and nearby private users is indicated in the log from 200 feet to 800 feet. A RAT indicated that the fluid moved down the tubing into the injection interval and that there was no upward migration of injection fluid above the injection zone. Also, the RAT survey revealed the leak-free condition of the tubing, casing strings, and packer within the test interval. Upon demonstration of mechanical integrity, the well was put back in service (see Golden StrataServices, Inc. Mechanical Integrity Test Report submitted with this petition) [42].

#### 6.2.4 WDW-110 (Well 1-A)

Following is a summary and chronology of the maintenance, repair work and mechanical integrity testing done on the Bay City Plant WDW-110. All depths are referenced from the Kelly Bushing Elevation of 52 feet above mean sea level unless otherwise noted.

##### 6.2.4.1 Summary of Drilling Operations (WDW-110)

The drilling of WDW-110 began on May 21, 1973 and the well was drilled to a total depth of 5,935 feet into the basal Miocene section. During the completion of the well, drilling equipment became lodged in the hole at 5,748 feet. After several attempts to push the fish to the bottom of the hole, a cement plug (using 300 sacks of Dowell common and 110 sacks of class "H" cement) from 5,704 feet to 5,767 feet was established. The hole was then side tracked to a total depth of 5,922 feet.

The original casing design for WDW-110 consists of 1,396 feet of surface casing (13 3/8-inch, 54.5-lb/ft., K-55) cemented to the surface with 950 sacks of Halliburton Lite and 300 sacks of Trinity type A cement. The upper string of the protective casing (9 5/8-inch, 40-lb/ft, K-55) runs from the surface to 4,624 feet. The lower string (9 5/8-inch, 43.5-lb/ft., K-55) is from 4,624 feet to 5,656 feet. This casing was cemented to the surface in a lower stage (440 sacks of Dowell Litewate and 1.218 gallons of Epoxy cement) and an upper stage (820 sacks Dowell Litewate and 1.812 gallons of epoxy cement) using a diversion tool (DV) set at 3,694 feet. Injection operations in WDW-110 began on August 17, 1973. Currently, waste is injected through slots in the screen from 5,710 feet to 5,921 feet in the sidetrack hole.

#### 6.2.4.2 Workover History (WDW-110)

August 23, 1973

WDW-110 was acidized in an attempt to increase injection flow rate [39].

October 4, 1973 to October 16, 1973

Due to brine flow from the top of the annulus, WDW-110 was shut down. A radioactive tracer log and fluid flow pattern log were run but these were unsuccessful in finding the leak. The injection tubing was then pulled and examined, and five bad collars and several bad joints were found. Well was pressure tested overnight then put back in service [40].

October 1, 1984 to May 2, 1985

A CET and an acoustic caliper log indicated that there was a two foot gap between the bottom of the overshot and the top of the screen. A PAL log and electromagnetic thickness log indicated a split in the casing at 5,572 feet with possible holes at 5,447 feet and 5,482 feet.

The first ten inches of the packer showed significant damage. Also, the polished bore receptacle (PBR) appeared to be mechanically damaged in areas.

Epoxy resin cement was used to repair the casing damage at 5,517 feet. During this workover the injection tubing was changed from 6 5/8-inch Fibercast tubing to 5,628 feet of 5 1/2-inch Fiberglass Systems 2,000 psi fiberglass pipe. Also a new 5 1/2" x 9 5/8" AVA dual packer was set at 5,621 feet with AVA packer seals at 5,633 and a new 5 1/2" x 9 5/8" AVA RPB packer with an ASU anchor at 5,037 feet to isolate corroded casing. Before the well was then put back in service, pressure and RAT tests were run to demonstrate mechanical integrity [41].

November, 1988

Mechanical integrity was demonstrated on WDW-110 by using an annulus pressure test, temperature survey, bottom hole pressure fall-off survey, and RAT. Also, the bottom hole pressure(BHP) and bottom hole temperature (BHT) were recorded as 2538 psig and 160°F at 5615 feet.

The MIT began with an annulus pressure test of 650 psig for 60 minutes with zero pressure bleed off. A temperature log revealed normal fluctuations through the surveyed interval. A RAT indicated that all injected fluid moved down the tubing and into the injection interval and that there was no upward migration of injected fluid above the injection interval. Also, the RAT survey revealed the leak-free condition of the tubing, casing strings, and packer within the test interval. Upon demonstration of mechanical integrity, the well was put back in service (see Golden StrataServices, Inc. Mechanical Integrity Test Report) [42].

### 6.2.5 Effects of Well Stimulations on Injection and Confining Zones

Due to the potential for well stimulation procedures to have detrimental effects on the ability of the injection and confining zones at the Bay City Plant, an analysis of this topic has been done and the results are presented below. The conclusion of the analysis is that it can be reasonably stated that the infrequent acidizations on the Bay City Plant injection wells have had no substantial effect on the ability of the injection and confining zones to contain fluid movement for 10,000 years.

The reasons for this conclusion are that; 1) most of the injection interval material is silica (quartz) which is not usually effected by acid (true for HCl but not for HF acid), 2) acidizations are carefully designed using laboratory processes to prevent detrimental effects on formation material, 3) the acids introduced during acidizations are quickly neutralized by the indigenous carbonates and clays in the injection interval, 4) the acidizations take place over a short period of time (hours) and consist of relatively low volumes of acid in relation to the volumes of injected wastes and native formation fluids, 5) the injected acid is usually in contact with any formation material in the subsurface for only a short period of time before being flushed ahead of any waste injected after the acidization procedure, 6) the acid-formation reaction is very rapid and the injected acid is dispersed, reacted, and diluted within a relatively short radius from the wellbore causing it to not affect the characteristics of subsurface formations over a very large areal distance from the injection well, and 7) the acid is contained within the injection zone by shales overlying the injection interval and never comes in contact with the confining zone.

Acidization is the only method of well stimulation used at the Bay City Plant to increase the injectivity of the wells. Hydraulic fracturing has not been used on the injection wells. Although nitrogen jetting procedures have been used at the site to clean out the well tubulars and completed intervals, the nature of the procedure

does not effect the formation materials. The injection wells at the Bay City Plant were stimulated as follows:

<u>Well</u>	<u>Date</u>	<u>Stimulation Type</u>
WDW-14 (Well 2)	11-21-68	Acid
WDW-14 (Well 2)	12-05-68	Acid
WDW-14 (Well 2)	02-06-80	Acid
WDW-32 (Well 3)	01-24-68	Acid
WDW-110 (Well 1A)	08-23-73	Acid

The purpose of injection well acidization is 1) to increase formation porosity and permeability or 2) dissolve precipitates in the well or around the wellbore. Typically, the acid is pumped into the well and delivered to the injection interval sandstones. The mineralogical composition of the injection interval sands used for waste disposal at the Bay City Plant are similar to most Gulf Coast Miocene sandstones in that they are composed primarily of quartz (silica) with lesser amounts of carbonate, clays, and feldspar present. A characteristic of quartz is that it is essentially non-reactive with most acids [43]. Thus, the majority of the injection interval material at the Bay City Plant is not substantially effected by the well acidizations. The reactions that do occur during the acidizations usually take place between the accessory mineral grains and matrix material such as the carbonates and clays.

Detailed studies have been done to determine the reactions between acids and typical Gulf Coast sandstones and shales [43]. These studies result in the determination that an acid introduced into an injection interval would be quickly neutralized by the various

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chemical reactions. The reactions that take place between indigenous carbonates and acids introduced into an injection interval take place especially quickly resulting in a rapid neutralization of the acid and the formation of carbon dioxide, water, and calcium or magnesium salts. Sodium montmorillonite and other naturally occurring clay minerals have been shown to react with acids via displacement of structural metallic ions in clays by hydrogen from acids [43]. Products of acid-clay reactions are free metallic ions such as aluminum and magnesium and altered clay structures containing hydrogen. These reaction products do not substantially affect the containment characteristics of the injection or confining zone material.

Once the acid is injected into the injection interval during a well stimulation it can either sink to the bottom of the injection sand or rise to the top and come into contact with the overlying or underlying shale layers. Studies have been done to determine the extent of typical Gulf coast shale - acid interactions. The results indicate that even if the most reactive acid (HF) was injected for an entire year, the maximum shale - acid reaction would be measured in inches per year. Since there is more than 50 feet of permitted shale layer overlying the upper Miocene injection interval at the Bay City Plant, and since the well stimulations were measured in hours, there has been only minimal shale layer effect due to the well stimulations. As a result the acid is contained within the permitted injection zone.

Since the acid stays in the injection zone, the confining zone is not effected by acid stimulations, because the acid never actually comes in contact with the confining zone shale.

In summary, acid stimulations increase injectivity by the reaction of the acid with the clays or other minerals in the sandstone, and by dissolving precipitates in the wellbore. Most acid has no substantial impact on quartz, the major component of the injection sands. Also, before an acidization is performed, a detailed site-specific study is conducted so that the proper program is used to stimulate the well.

This study determines the type of acid to be used, the concentration, and the amount required to restore injectivity without adversely effecting the injection zones. Thus, it can be reasonably stated that the infrequent acidizations on the Bay City Plant wells have had no substantial effect on the ability of the injection zone and confining zones to contain fluid movement for 10,000 years.

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J. C. 11/1

## TEXAS WATER COMMISSION

B. J. Wynne, III, Chairman  
John E. Birdwell, Commissioner  
Cliff Johnson, Commissioner



John J. Vay, General Counsel  
Michael E. Field, Chief Hearings Examiner  
Brenda W. Foster, Chief Clerk

Allen Beinke, Executive Director

November 1, 1989

Oscar Cabra, Jr., P.E.  
Chief, Water Supply Branch  
U. S. Environmental Protection Agency  
Region VI  
1445 Ross Avenue  
Dallas, Texas 75202

Re: 40 CFR 148 Land Ban "No-migration" Petition Summary  
Hoechst Celanese Chemical Group, Inc. - Bay City

Dear Mr. Cabra:

Enclosed is the HSWA petition review and summary report prepared by the Underground Injection Control Unit of my staff for the above cited facility. The report is a result of an extensive staff review of the land ban petition submitted by the facility pursuant to 40 CFR Part 148 Subpart C.

The staff has determined that the petition is in compliance with the petition standards and procedures of Subpart C. If you have any questions please contact Mr. Thomas P. Roth of my staff at 512/463-8425.

Sincerely,

Russell S. Kimble, Chief  
Hazardous and Solid Waste Enforcement Section  
Hazardous and Solid Waste Division

DR/da

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WAT 18-6-5-9 Section 2

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# TEXAS WATER COMMISSION

B. J. Wynne, III, Chairman  
Paul Hopkins, Commissioner  
John O. Houchins, Commissioner



October 3, 1989

Allen Beinke, Executive Director  
Michael E. Field, General Counsel  
Brenda W. Foster, Chief Clerk

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OCT 5 1989

EPA 6W-S  
REGION VI

Mr. I. O. Coleman, Jr.  
Environmental Affairs Group Leader  
Hoechst Celanese Chemical Group, Inc.  
Bay City Plant  
P.O. Box 509  
Bay City, Texas 77404-0509

Re: Response to Hoechst Celanese (Bay City Plant) Comments  
Regarding Draft Permit for Waste Disposal Well, WDW-277

Dear Mr. Coleman:

In your letter of September 14, 1989, you commented on several areas of the above referenced draft permits and requested the U.I.C. staff reevaluate the drafts accordingly. The staff has reviewed your comments and responds as follows:

1. The injection zone was not specifically defined in the draft permit dated June 27, 1989, since the revised E.P.A. definitions of injection zone and injection interval were not final at the time the draft was originally completed. Any new draft permits will be modified to reflect the proposed injection zone and injection interval pursuant to 31 TAC § 331.2 and 40 CFR §§ 146.61 and 146.62.

It was noted in your comments that, due to molecular diffusion, you intend to increase the injection zone, from the 3,150 to 6,350 feet requested in the application, to 2,900 to 6,350 feet. Please note that the injection zone defined in the permit must match the injection zone requested in the Hoechst Celanese Bay City Plant, No Migration Petition.

2. The specific gravity restriction of 1.01 was based on the wastestream analysis given in Tables 9-1 and 9-2 (pages 67 and 68) of the technical report document. All subsequent pressure build-up and maximum allowable surface injection injection pressure (MASIP) modeling was based on this figure. Increasing the specific gravity to 1.10 will be considered after the T.W.C. has completed a detailed sensitivity analysis of these models.

WAT 18-6-5-9

*Ronni / P.D.*  
*Wm*

# TEXAS WATER COMMISSION

B. J. Wynne, III, Chairman  
Paul Hopkins, Commissioner  
John O. Houchins, Commissioner



Allen Beinke, Executive Director  
Michael E. Field, General Counsel  
Brenda W. Foster, Chief Clerk

February 28, 1989

Mr. I.O. Coleman  
Environmental Manager  
Hoechst-Celanese  
Post Office Box 509  
Bay City, Texas 77414

Re: Notice of Deficiency, Petition for EPA Facility  
EPA I.D. No. TXD026040709

Dear Mr. Coleman:

Enclosed is a list of deficiencies on the referenced petition. The Commission has tentatively scheduled a meeting at the Stephen F. Austin Building at 10:00 a.m. on March 2, 1989. We request that you bring your technical staff and/or consultant with you to review these deficiencies at that time.

If the meeting time is not convenient please call Mr. Thomas Roth at 512/463-8282 so that alternate arrangements may be made.

Sincerely,

A handwritten signature in black ink that appears to read "Samuel B. Pole".

Samuel B. Pole, Chief  
Hazardous and Solid Waste Enforcement Section  
Hazardous and Solid Waste Division

TR:ok

cc: Phil Dellinger, EPA-Region VI, 1445 Ross Ave., Dallas, Tx., 75202

WAT 18-6-5-9

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REGION VI

02/27/1989 16:07 TEXAS WATER COMMISSION

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89 FEB 28 AM 8:20

TEXAS WATER COMMISSION

Stephen F. Austin Bldg.  
P.O. Box 13087  
Austin, Texas 78711

Wesley M  
Phil Ronni

Direct Telex Number: 512/463-8317

Date: 2-27-89

Panafax UF-600 SF

TELECOMMUNICATIONS COVER PAGE

TO: Phil Dellinger  
PERSON TO CONTACT  
EPA Region VI  
COMPANY NAME  
Dallas TX  
TOWN STATE

FROM: TEXAS WATER COMMISSION  
Tom Roth  
PERSONS NAME  
HYSW Enf  
DIVISION  
(812) 463-8282  
PHONE NUMBER

TELEFAX NUMBER

COMMENTS: Mail Drop 6W-SU RECEIVED

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REGION VI

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the operator at 512/463-7813.

Operator: Janice

WAT 18-6-5-9

WAT 18-6-5-4

Hoechst Celanese  
Bay City Plant  
Petition Deficiencies

**AREA OF REVIEW :**

1. Table 4-1 and the pressure contour plots shown in Figures 4-1 through 4-4 only demonstrate the cone of influence (COI) through the year 2000. An expanded discussion of the COI will be necessary if the petitioner intends to petition for operation of the wells past the year 2000.
2. The COI needs to be graphically illustrated to facilitate determining whether or not contained wells satisfy the no migration standard.
3. An illustration graphically depicting the 10,000 year plume migration including the location of all artificial penetrations which penetrate the injection zone (containment interval plus injection interval) is needed.
4. No differentiation in regard to the non-endangerment standard and the no migration standard was included in the petition document. It is assumed that the 12 wells identified as "potential problem wells" in Section 4.4.7. (15, 2, 9, 11, 21, 25, 31, 20, 23, 24, 26 and 28) refer to the non-endangerment issue since no mention was made of wells within the COI or area of the plume. In this regard the petitioner needs to provide a discussion of the no migration standard.
5. The following (9) wells within the 2.5 mile AOR do not satisfy the non-endangerment standard: 2, 15, 20, 21, 23, 24, 25, 26 and 28. Within the 2.0 mile area of review only one well does not meet the non-endangerment standard: 15. If they were contained within the area of the plume or the cone of influence the following (17) wells would not satisfy the no-migration standard, if evaluated solely on the basis of cement across the top of the injection zone: 2, 3, 4, 5, 7, 10, 11, 15, 16, 20, 21, 22, 25, 26, 27, 28 and 32. Only wells 2, 9, 11, 15, 20, 21, 23, 24, 25, 26, 28 and 31 were addressed in the modeling. All wells not satisfying non-endangerment and no migration need to be addressed in the modeling.

**Regional Geology**

1. Provide source of information for Figure 3-1 (stratigraphic column), and revise to show relative positions of injection interval, containment interval, injection zone, and confining zone.

2. Provide regional structure contour map on top of the injection zone and confining zone. Maps should be of sufficient scale to justify modeling assumption of lateral continuity of the subject zones.
3. Specify on Figure 3-4 whether earthquake magnitudes are based on the Richter or Mercalli scales, and also provide a key or tabulated explanation of the scale used.
4. In petition Section 3.2.2, describe the positions of the injection interval, containment interval, injection zone, and confining zone within the stratigraphic section.
5. Show the location of the Bay City plant on Figure 3-5.
6. Provide a regional cross section to show continuity of the injection interval, injection zone, and confining zone. Cross section should be accompanied by a map showing the cross section line and all well control for the cross section.

#### Local Geology

1. Since the time of preparation of the petition's geologic maps and cross sections, the concepts of (1) an injection interval, and (2) an overlying containment interval, as being the two necessary constituents of a suitable injection zone, have been developed and advanced by EPA as fundamental aspects of the demonstration of no migration. Further, the injection zone must be overlain by a confining zone into which no hazardous waste migration will occur within 10,000 years. In this regard, check and revise all geologic maps and cross sections as necessary to provide zone and interval labeling consistent with the EPA definitions of injection interval, containment interval, injection zone, and confining zone.
2. Modify all geologic maps and cross section as necessary to show the extent of the 10,000 year injectate plume, and to show geologic conditions throughout both the 2-mile radius AOR and the 10,000 year plume.
3. Provide sources of base maps and well data on all geologic maps. Also, provide the datum for depth contours on all geologic structure maps.
4. On geologic cross sections, flag all log depths every 1,000 feet to aid interpretation without use of a magnifying glass.
5. For all wells shown on geologic cross sections, provide full-scale logs which are marked to show formation contacts, and the injection interval, containment interval, injection zone and confining zone.

6. Provide logs for each of the Bay City plant's permitted waste disposal wells, labeled to show formation contacts, and the injection interval, containment interval, injection zone, and confining zone.
7. Provide cross section to show characteristics of the fault described in Section 3.3.1 and depicted on Appendix 3-5 and Appendix 3-6.
8. Provide name of salt dome located approximately 10 miles north of the Bay City plant, as described in Section 3.3.1.
9. Provide a type log labeled to show how all layers used in modeling correspond directly to actual geologic units in the local stratigraphic section.
10. Provide copies of all references if they are not readily available from libraries of the Texas Water Commission, the University of Texas, Texas A & M University, and/or the Underground Injection Practices Council.

#### Hydrogeology

1. Results of laboratory and field tests are summarized on tables, but the actual reports from the testing contractors are not included in the petition. Consequently, it is not possible to verify the information presented as model parameters using the petition itself. Original material that should be provided would include:  
core laboratory descriptions and test results, drill stem test results, bottom hole pressure test data, injectivity and falloff test data, wireline porosity logs covering modeled hydrologic units which were not cored (preferably with electric logs at the same scale), among others.
2. References which are unpublished reports or analyses and/or which are not readily available from geological libraries should be included as appendices to the petition. If referenced data are located in another section of the petition (such as the Core Lab and Halliburton core analyses discussed in the local geology section and located in the compatibility section), the reference format should also include that data's location within the petition.

#### Geochemistry

1. Appendices 2-11 and 2-12, which are concerned with molecular diffusion, are not complete.

#### Modeling Comments

1. Appendix 2-11 and 2-12 are missing.

2. Model documentation does not address simulator validation adequately. How were the simulators validated.
3. The 10,000 year movement of waste is a simple advective calculation which does not include the effects of dispersion. A multiplying factor should be developed for this calculation as well as for the shorter term simulations.
4. Some comments need to be made concerning the fact that the injection fluid is less dense than the formation fluid. What effect might this have on the system?
5. Cross sections should be included in the modeling portion of the petition. The cross sections should show the physical system as idealized for the purposes of modeling, contrasted against what the system is known to be. Formation thicknesses, etc. should be shown through the 10,000 year travel time. Modeling results (plume locations, etc.) should be shown on the cross sections as well.
6. A figure should be included showing the 10,000 year plume on the area of review map.
7. Discussion should be included pertaining to what effect there may be from the variation in thickness of the injection aquifer (50 to 300 ft) at various distances from the injection wells.
8. There should be more discussion on the direction of the hydraulic gradient of the injection aquifer. What is the basis for the South or Southeast movement of the 10,000 year plume.



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TEXAS NATURAL RESOURCE CONSERVATION COMMISSION



**AN ORDER affirming the Executive Director's approval of the  
Applications of Hoechst Celanese Chemical Group, Ltd.  
for transfer of ownership of Class I UIC Permit Nos.  
WDW-244, 245, 246, 33, 45, 283, 14, 32, 49, 110 and 277**

6WD-5

66 ADR 17 FEB 1996  
LAWYER  
SOURCE WATER  
PROTECTION BRANCH

DOCKET NO. 96-0174-UIC

On December 29, 1995, the Executive Director of the Texas Natural Resource Conservation Commission approved, pursuant to 30 Texas Administrative Code Chapter 263, the applications of Hoechst Celanese Chemical Ltd. to transfer the ownership of eleven Class I Underground Injection Control Permits. These Permits are Nos. WDW-244, 245 and 246, in Pampa, Gray County, Texas, which were transferred from Celanese Chemical Company, Inc. to Hoechst Celanese Chemical Group, Ltd.; Nos. WDW-33, 45, and 283, in Houston, Harris County, Texas, which were transferred from Hoechst Celanese Chemical Group, Inc. to Hoechst Celanese Chemical Group, Ltd.; and Nos. WDW-14, 32, 49, 110 and 277, in Bay City, Matagorda County, Texas, which were transferred from Hoechst Celanese Chemical Group, Inc. to Hoechst Celanese Chemical Group, Ltd. Copies of these approvals issued by the Executive Director are attached to this Order as Exhibit "A."

On January 10, 1996, the Texas Natural Resource Conservation Commission considered these transfers and affirmed the Executive Director's actions in approving the transfers of ownership in the approvals attached as Exhibit "A."

NOW, THEREFORE, BE IT ORDERED BY THE TEXAS NATURAL RESOURCE CONSERVATION COMMISSION THAT the applications of Hoechst Celanese Chemical Group, Ltd. for transfer of ownership of Class I Underground Injection Control Permit Nos. WDW-244, 245, 246, 33, 45, 283, 14, 32, 49, 110 and 277 are affirmed. The Chief Clerk of the Texas Natural Resource Conservation Commission forward a copy of this Order to all parties. If any provision, sentence, clause, or phrase of this Order is for any reason held to be invalid, the invalidity of any portion shall not affect the validity of the remaining portion of the Order.

Date Issued: JAN 17 1996

Texas Natural Resource  
Conservation Commission

ATTEST:

*Gloria A. Vasquez*  
Gloria A. Vasquez, Chief Clerk

*B. McBee*  
Barry R. McBee, Chairman

## **ATTACHMENT A**

# TEXAS NATURAL RESOURCE CONSERVATION COMMISSION



## TEXAS NATURAL RESOURCE CONSERVATION COMMISSION PERMIT TRANSFER OF CLASS I UIC PERMIT NO. WDW-14

ISSUED ON MAY 13, 1991

TO HOECHST CELANESE CHEMICAL GROUP, INC.

Class I UIC Permit No. WDW-14 is hereby changed:

Provision I, Page 1

Permittee:

Hoechst Celanese Chemical Group, Inc.  
P.O. Box 509  
Bay City, Texas 77414

shall be replaced with

Permittee:

Hoechst Celanese Chemical Group, Ltd.  
P.O. Box 509  
Bay City, Texas 77414

This document is part of the permit and should be attached thereto.

APPROVED, ISSUED AND EFFECTIVE this 29th day of December, 1995 in accordance with 30 Texas Administrative Code §305.64.

ATTEST: Blaria A. Varguez

  
\_\_\_\_\_  
For The Commission

# TEXAS NATURAL RESOURCE CONSERVATION COMMISSION



TEXAS NATURAL RESOURCE CONSERVATION COMMISSION  
PERMIT TRANSFER OF CLASS I UIC PERMIT NO. WDW-49

ISSUED ON MAY 13, 1991

TO HOECHST CELANESE CHEMICAL GROUP, INC.

Class I UIC Permit No. WDW-49 is hereby changed:

Provision I, Page 1

Permittee:

Hoechst Celanese Chemical Group, Inc.  
P.O. Box 509  
Bay City, Texas 77414

shall be replaced with

Permittee:

Hoechst Celanese Chemical Group, Ltd.  
P.O. Box 509  
Bay City, Texas 77414

This document is part of the permit and should be attached thereto.

APPROVED, ISSUED AND EFFECTIVE this 29th day of December, 1995 in accordance with 30 Texas Administrative Code §305.64.

ATTEST: Maria A. Vazquez

  
\_\_\_\_\_  
For The Commission

# TEXAS NATURAL RESOURCE CONSERVATION COMMISSION



## TEXAS NATURAL RESOURCE CONSERVATION COMMISSION PERMIT TRANSFER OF CLASS I UIC PERMIT NO. WDW-277

ISSUED ON JULY 7, 1991

TO HOECHST CELANESE CHEMICAL GROUP, INC.

Class I UIC Permit No. WDW-277 is hereby changed:

Provision I, Page 1

Permittee:

Hoechst Celanese Chemical Group, Inc.  
P.O. Box 509  
Bay City, Texas 77414

shall be replaced with

Permittee:

Hoechst Celanese Chemical Group, Ltd.  
P.O. Box 509  
Bay City, Texas 77414

This document is part of the permit and should be attached thereto.

APPROVED, ISSUED AND EFFECTIVE this 29th day of December, 1995 in accordance with 30 Texas Administrative Code §305.64.

ATTEST: Maria A. Vazquez

  
\_\_\_\_\_  
For The Commission

March 4, 1990

FACT SHEET

For proposed approval to allow injection of restricted hazardous wastes into the following injection well(s):

Applicant: Hoechst Celanese Chemical Group, Inc.  
Bay City Plant  
Farm Road 3057  
P. O. Box 509  
Bay City, Texas 77414

Facility Location: Matagorda County

<u>Permit Number</u>	<u>Well Number</u>
WDW-14	2
WDW-32	3
WDW-49	4
WDW-110	1-A
WDW-277	5

Issuing Office: U.S. Environmental Protection Agency  
Region 6  
First Interstate Bank Tower  
1445 Ross Avenue  
Dallas, Texas 75202-2733

1. The Environmental Protection Agency (EPA) proposes to allow the injection of restricted hazardous wastes into the well(s) described above and in the petition demonstration document.
2. This fact sheet or similar statement of basis is required under Title 40 of the Code of Federal Regulations, §§ 124.7 and 124.8 (40 CFR §§ 124.7 and 124.8, as referenced by 40 CFR §§ 148.22 and 124.10).
3. The following is an explanation of the derivation of the proposed decision, which is categorized according to the criteria outlined in 40 CFR Part 148. [53 Fed. Reg., 28118, (1988)]

Summary

The EPA land disposal restrictions promulgated under § 3004 of the Resource Conservation and Recovery Act prohibit the injection of hazardous waste unless a petitioner demonstrates to the EPA that there will be no migration of hazardous constituents from the injection zone for as long as the waste remains hazardous. These no migration demonstrations include a description of the well operations, geologic siting, and waste stream characteristics. They also include modeling

strategies which incorporate all the above mentioned information and utilize mathematical equations to predict pressure build up and waste movement.

The Hoechst Celanese - Bay City petition described its well operation through a discussion of the well construction, well stimulations, injection pressures, and injection volumes. The site location and geologic conditions were presented through a discussion of the depositional environment, well logs, cross-sections, well tests, geologic maps, and well records. The characteristics of the injection wastestream were described and evaluated for compatibility with the injection and confining zones. Hoechst Celanese incorporated all this information into a modeling strategy which predicted the pressure build up and waste movement for the Bay City site. The waste plume, under worst conditions, was predicted to move laterally approximately 7.3 miles southeast in the upper interval and 6.6 miles southeast in the lower interval in 10,000 years. Vertical movement is approximately 128 feet. Both of these distances are within the injection zone.

In addition to the reasonably conservative data and assumptions in the no migration demonstration, the following factors augment the demonstration of no migration:

- (a) The petition over predicts pressure buildup and waste plume extent by modeling the injection rate at 750 gpm for the upper interval and 600 gpm for the lower interval which is more than the historic rate of 251 gpm for the upper interval and 190 gpm for the lower interval.
- (b) The petition over predicts the injected hazardous constituent concentration by assuming the constituent concentration is two orders of magnitude greater than the measured value.
- (c) The petition is reasonably conservative by not taking into account the degradation of the contaminant in the injection zone. Examples of degradation which were not considered are adsorption, oxidation, hydrolysis, temperature, and microbiological degradation.
- (d) In the evaluation of artificial penetrations, the petition does not take into account the natural occurrence of wellbore closure. This occurs within the Gulf Coast region due to the unconsolidated sediments.

Therefore, after a detailed and thorough review of the Bay City site petition, the EPA proposes that Hoechst Celanese has demonstrated, to a reasonable degree of certainty, that there will be no migration of hazardous constituents from the injection zone for a time period of 10,000 years.

The factors considered in the formulation of this proposed petition decision are described below.

#### Artificial Penetrations

The area around the Class I hazardous waste well cited in the petition must be evaluated to ensure that the injection activity will not endanger Underground Sources of Drinking Water (USDW) by causing movement of fluids into improperly sealed, completed, or abandoned wells. The petition applicant submitted information on all wells penetrating the injection or confining zones within 2.5 miles of the injection wells.

- (a) Artificial penetrations within the 2.5 mile radius are plugged or constructed to prevent the endangerment to an USDW.
- (b) There are 32 wells within the area of review (AOR) which meet this standard.
- (c) The calculated cone of influence (COI) is less than 1230 feet.

In addition to the nonendangerment standard, some artificial penetrations must also meet the no-migration standard. These artificial penetrations are wells which penetrate the injection zone and are located within the area of the waste plume movement over 10,000 years.

- (a) The artificial penetrations which penetrate the injection zone and are located within the area of the waste plume movement over 10,000 years are plugged or constructed to prevent the migration of hazardous waste from the injection zone.
- (b) There are 13 wells within the area of the plume which meet the no-migration standard.
- (c) All wells met this standard through a demonstration that waste movement due to pressure and molecular diffusion in an artificial penetration will remain within the injection zone.

### Mechanical Integrity Testing (MIT) Information

To assure that the wastes will reach the injection zone, a petitioner must submit the results of pressure and radioactive tracer tests according to §148.20 (a)(2)(iv). A well has mechanical integrity when there is no significant leak in the casing, tubing, or packer, and when there is no significant fluid movement into an USDW through vertical channels adjacent to the injection well bore. The petition demonstrates that the active wells have been tested and do satisfy the above criteria.

<u>Well No.</u>	<u>Date of Pressure Test</u>	<u>Date of Radioactive Tracer Survey</u>
WDW-14	10-26-89	10-26-89
WDW-32	10-24-89	10-24-89
WDW-49	10-25-89	10-25-89
WDW-110	10-31-89	10-31-89
WDW-277	Not Drilled	

Injection well WDW-277 must meet the requirements of the Texas Water Commission injection permit. Results of the pressure and radioactive tracer tests must be submitted to the EPA Region 6 for approval prior to injection of restricted hazardous waste in well WDW-277. In addition, information obtained from the drilling and construction of the WDW-277 well shall be submitted to the EPA Region 6 to ensure the basis for the petition decision continues to remain valid. The information should include well logs, geologic core analysis of the confining and injection zones, a hydrogeologic compatibility determination, and formation tests.

### Quality Assurance

According to §148.21 (a)(4), the Hoechst Celanese - Bay City petition demonstrates that proper quality assurance and quality control plans were followed in preparing the petition demonstrations.

Specifically, Hoechst Celanese has followed appropriate protocol in identifying and locating records for artificial penetrations within the Area of Review. Information regarding the geology, waste characterization, hydrology, reservoir modeling, and well construction has also been adequately verified or bounded by worst-case scenarios.

### Regional and Local Geology

Class I hazardous waste injection wells must be located in areas that are geologically suitable. The injection zone must have sufficient permeability, porosity, thickness, and

areal extent to prevent migration of fluids into USDW's. The confining zone must be laterally continuous and free of transmissive faults or fractures to prevent the movement of fluids into an USDW and must contain at least one formation capable of preventing vertical propagation of fractures. The Hoechst Celanese-Bay City facility is sited in an area meeting the above criteria.

An evaluation of the structural and stratigraphic geology of the local and regional area has determined that the Hoechst Celanese-Bay City facility is located at a geologically suitable site. The injection zone is of sufficient permeability, porosity, thickness, and areal extent to meet requirements stated in 40 CFR Part 148. The confining zone is laterally continuous and free of transecting, transmissive faults or fractures over an area sufficient to prevent the movement of fluids into a USDW.

- (1) Depth of Confining Zone: 2350 feet  
Depth of Injection Zone: 2900 feet  
Depth of Injection Intervals: 3350-3600 feet  
5700-5950 feet
- (2) The geologic conditions were presented through a discussion of the depositional environment, well logs, cross-sections, well tests, and geologic maps.
- (3) The structure and isopach maps provided confidence in the geologic description.
- (4) The geologic cross-sections demonstrated that the injection zone is laterally continuous. This justified some of the modeling assumptions.
- (5) Pressure falloff tests support the injection zone permeability parameter in the modeling strategy.

#### Hydrogeology

According to §148.20 (a)(1), a petitioner must submit hydrogeologic information in order to study the effects of the injection well activity. Hoechst Celanese provided hydrogeologic information in the petition which demonstrates that USDW's are properly protected. The base of the lowermost USDW is at 1300 feet.

#### Characteristics of Injected Fluids

According to §148.22 (a), the characteristics of the injection wastestream must be adequately described in order to determine the wastestream's compatibility with the injection zone. These characteristics are described in the petition and the description is adequate and complete.

The waste contain the following EPA hazardous waste numbers: K009, K010, D001, D002, U001, U002, U031, U112, U123, U140, U154, U197, U226, F001, F002, Hexavalent Chromium

#### Geochemistry and Injected Waste Compatibility

According to §148.21 (b) (5), a petitioner must describe the geochemical conditions of the well site. The physical and chemical characteristics of the injection zone and the formation fluids in the injection zone were described in the petition. This description included a discussion of the compatibility of the injected waste with the injection zone.

- (1) The geochemistry of the injection zone was described through the use of core data.
- (2) Hoechst Celanese provided evaluations which demonstrated that the waste stream would not adversely alter the confining capabilities of the injection and confining zones.

#### Modeling Strategy

According to 40 CFR §148.21(a)(3), in demonstrating no-migration of hazardous constituents from the injection zone, predictive models shall have been verified and validated, shall be appropriate for the specific site and wastestreams, and shall be calibrated for existing sites. The modeling strategy consisted of a combination of analytical models. All the models used were identified as being verified and validated according to the information submitted in the petition. This information consisted of actual model documentation or references of methods or techniques that are widely accepted by the technical community. The petition describes the predictive models used and demonstrates that the above criteria are met.

According to 40 CFR §148.21(a)(5), reasonably conservative values shall be used whenever values taken from the literature or estimated on the basis of known information are used instead of site-specific measurements. Many variables were required to be quantified in order to employ the models used in the petition. All parameters were conservatively assigned to produce worst case conditions for either pressure buildup or waste movement.

According to 40 CFR §148.21 (a)(6), a petitioner must perform a sensitivity analysis in order to determine the effect of uncertainties associated with model parameters. Hoechst Celanese provided this sensitivity analysis in its petition. Through conservative model parameter assignments within this analysis, worst case scenarios for pressure buildup and waste movement were investigated and reported.

Results

## 1. Operational Life

Estimated Operational Life: Year 2000  
 Maximum Permitted Injection Rates:

WDW-14	Combined annual average of 750 gpm in upper interval
WDW-32	
WDW-49	
WDW-110	Combined annual average of 600 gpm in lower interval
WDW-277	

## Maximum Pressure Buildup [at wells]:

Upper interval	87 psi
Lower interval	86 psi

## Maximum Lateral Waste Movement:

Upper interval	0.9 miles
Lower interval	0.8 miles

Maximum Vertical Waste Movement: <2.0 feet

## 2. 10,000 Year Post-Injection Period

## Background Gradient or Velocity:

Upper interval	2.8 feet/year in southeast direction from site
Lower interval	3.2 feet/year in southeast direction from site

Waste Density Effects Yes x N/A \_\_\_\_\_  
 Movement Due to Hydrocarbon Production Yes \_\_\_\_\_ N/A \_\_\_\_\_

X  
 Maximum Waste Concentration Reduction Factor is  $10^{-6}$

## Maximum Lateral Waste Movement:

Upper interval	7.3 miles in southeast direction from site
Lower interval	6.6 miles in southeast direction from site

Maximum Vertical Waste Movement is 128 feet in intact strata and 330 feet in mud.

October 3, 1991

FACT SHEET

For proposed approval of a reissuance of a previously approved exemption to the land disposal restrictions for the following injection wells:

Applicant: Hoechst Celanese Chemical Group, Inc.  
Bay City Plant  
Farm Road 3057, P.O. Box 509  
Bay City, Texas 77414

Facility Location: Matagorda County, Texas  
Permit Numbers: WDW-14, WDW-32, WDW-49, WDW-110, WDW-277  
Well Numbers: 2, 3, 4, 1-A, 5

Issuing Office: U.S. Environmental Protection Agency  
Region 6  
First Interstate Bank Tower  
1445 Ross Avenue  
Dallas, Texas 75202-2733

1. The Environmental Protection Agency (EPA) proposes to approve a request for an exemption reissuance to increase the range of the specific gravity of the injected waste stream and to include an additional injection well.
2. This fact sheet or similar statement of basis is required under Title 40 of the Code of Federal Regulations, § 124.7 and 124.8 (40 CFR 124.8 and 124.8, as referenced by 40 CFR § 148.22 and 124.10).
3. The following is an explanation of the derivation of the proposed decision.

Summary

The EPA land disposal restrictions promulgated under § 3004 of the Resource Conservation and Recovery Act prohibit the injection of hazardous waste unless a petitioner demonstrates to the EPA that there will be no migration of hazardous constituents from the injection zone for as long as the waste remains hazardous. These no-migration demonstrations include a description of the well operations, geologic siting, and waste stream characteristics. They also include modeling strategies which incorporate all the above mentioned information and utilize mathematical equations to predict pressure build up and waste movement. Celanese successfully demonstrated no migration for the injection wells at the Bay City facility and obtained an exemption to the land disposal restrictions on May 4, 1990.

Celanese Bay City has requested to expand the specific gravity range for the waste stream injected into the Upper and Lower Miocene formations. The approved petition currently specifies that the specific gravity of the injected fluid must lie within the range of 1.0032 to 1.0054 at 68°F. The requested specific gravity range is 1.00 to 1.10 at 68°F. Celanese remodeled the plume movement based on the requested specific gravity range. This additional modeling indicated that the plume would move farther during the 10,000 year time period than indicated in the original model. For this reason, an exemption reissuance is required instead of a modification. Therefore, all aspects of the petition are open to public comment.

As part of the exemption reissuance, the Bay City Plant also requested to add an additional well, WDW-277, to the Petition Exemption. This well, if drilled, would be located near WDW-110 and also inject into the Lower Miocene Formation. Injection rates for the Lower Miocene Formation are restricted to a monthly cumulative maximum average injection rate based on 400 gallons per minute. All aspects of modeling and operation for this well were covered in the original no migration demonstration.

The waste stream in the reissued petition will be identical to the injectate in the original petition in every respect except specific gravity. Therefore, there will be no change in molecular diffusion rates of individual constituents in the waste stream, or in the compatibility of the waste with the formation or formation fluid. The non-endangerment standard demonstrated in the initial petition will still be valid for vertical waste movement.

Celanese Bay City demonstrated that increasing the specific gravity range for the waste stream would result in no migration of hazardous constituents from the injection zone for a 10,000 year period, as required in 40 CFR Part 148. Based on the remodeling for the reissuance request, the maximum updip plume movement did not change. However, this modeling resulted in an additional downdip plume movement of approximately 6300'. The expanded plume area was reviewed with respect to the geology and to determine if any additional artificial penetrations will be encountered by the plume. The artificial penetration review was performed based on the specific protocol that is defined in the reissuance request. Only one additional well was identified within the plume area. This well was properly plugged to prevent migration of waste from the injection zone.

Therefore, the EPA is proposing to change the Petition Approval Conditions as shown below. (All additions have been underlined).

1. This exemption is for the four existing injection wells WDW-14, WDW-32, WDW-49 and WDW-110. The exemption also includes WDW-277. All wells were permitted by the Texas Water Commission.
2. Injection of restricted waste shall be limited to the injection intervals for the following wells:

Well No. WDW-14	3350 to 3600 feet. (log depth)
Well No. WDW-32	3350 to 3600 feet. (log depth)
Well No. WDW-49	3350 to 3600 feet. (log depth)
Well No. WDW-110	5700 to 5950 feet. (log depth)
<u>Well No. WDW-277</u>	<u>Equivalent interval to 5700 to 5950 feet in WDW-110</u>

These injection intervals occur in an injection zone occurring at a depth of 2900 feet to 6200 feet (log depth).

3. The cumulative monthly volume injected in WDW-14, WDW-32, and WDW-49 shall not exceed 33,480,000 gallons. The monthly volume injected in WDW-110 alone shall not exceed 26,784,000 gallons. The cumulative monthly volume injected in WDW-110 and WDW-277 (if drilled) shall not exceed 17,856,000 gallons.
4. The facility shall cease injection of restricted hazardous waste by December 31, 2000.
5. The characteristics of the injected waste stream other than specific gravity shall at all times conform to those of Section 2.1 in the petition. The specific gravity of the waste stream shall remain within a range of 1.00 to 1.10 at 68°F inclusive.
6. The final approval for injection is limited to the following hazardous wastes: K009, K010, D001, D002, U001, U002, U031, U112, U123, U140, U154, U197, U226, F001, F002, Hexavalent Chromium.
7. Hoechst Celanese must petition for approval to inject additional hazardous wastes which are not included in Condition No. 6, above. Hoechst Celanese must also petition for approval to increase the concentration of any waste which would necessitate the recalculation of the limiting concentration reduction factor and the extent of the waste plume. Petition modifications and reissuance should be made pursuant to 40 CFR 148.20 (e) or (f).

8. Hoechst Celanese shall annually submit to EPA the results of bottom hole pressure surveys for WDW-14, WDW-32, WDW-49, WDW-110, and WDW-277 (if drilled). These surveys shall have been performed after shutting in each well for a period of time sufficient to allow the pressure in the injection interval to reach equilibrium, in accordance with 40 CFR 146.68 (e)(1). This annual report should include a comparison of reservoir parameters determined from the falloff tests with parameters used in the approved no migration petition.
9. Upon the expiration, cancellation, reissuance, or modification of the Texas Water Commission's Underground Injection Control permit for Well Nos. WDW-14, WDW-32, WDW-49, WDW-110, and WDW-277 (if drilled) this exemption is subject to review. A new demonstration may be required if information shows that the basis of granting the exemption is no longer valid.
10. Injection well WDW-277 must meet the requirements of the Texas Water Commission injection permit. Results of the pressure and radioactive tracer tests must be submitted to the EPA Region 6 for approval, and if approved, the exemption will become effective and Agency authorization to begin injection of restricted hazardous waste in the WDW-277 injection well will be issued.
11. Information obtained from the drilling and construction of the WDW-277 injection well shall be submitted to the EPA Region 6 to ensure the basis for the petition approval continues to remain valid. This information should include well logs, geologic core analysis of the confining and injection zones, a hydrogeologic compatibility determination, and formation tests.
12. The drilling mud used in the drilling process of the WDW-277 injection well shall be properly disposed.

HOECHST CELANESE CHEMICAL GROUP, INC.  
BAY CITY, TEXAS  
WDW-14, WDW-32, WDW-49 & WDW-110  
MECHANICAL INTEGRITY TESTING

GOLDEN STRATASERVICES, INC.  
711 LOUISIANA SUITE 1600  
HOUSTON, TEXAS 77002  
(713) 222-9600

NOVEMBER, 1990

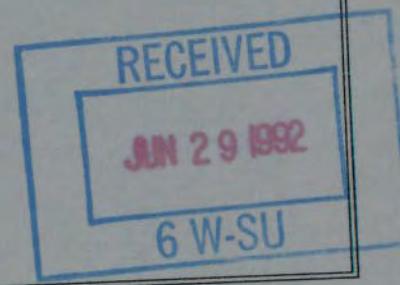


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2. Certificate of Calibration (All Wells)
2. Radioactive Tracer Survey Data
3. Gulf Coast Well Analysis Log Interpretation Letter
4. Static and Fall-Off Bottom Hole Pressure Data

B. WASTE DISPOSAL WELL 32

1. Annulus Pressure Data
2. Radioactive Tracer Survey Data
3. Gulf Coast Well Analysis Log Interpretation Letter

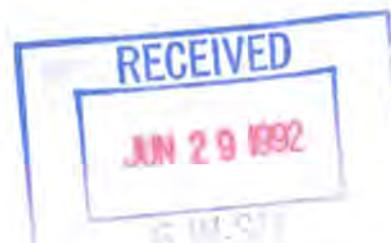
C. WASTE DISPOSAL WELL 49

1. Annulus Pressure Data
2. Radioactive Tracer Survey Data
3. Gulf Coast Well Analysis Log Interpretation Letter

D. WASTE DISPOSAL WELL 110

1. Annulus Pressure Data
2. Radioactive Tracer Survey Data
3. Gulf Coast Well Analysis Log Interpretation Letter
4. Static and Fall-Off Bottom Hole Pressure Data

E. REGULATORY CORRESPONDENCE



## 1.0 INTRODUCTION

### BACKGROUND

The attached report details the data and test results associated with the mechanical integrity testing (MIT) of Hoechst Celanese Chemical's (HCC) injection wells WDW-14 (Well #2), WDW-32 (Well #3), WDW-49 (Well #4) and WDW-110 (Well #1A). These active injection wells are located at the Hoechst Celanese facility near Bay City, Texas.

The logging portion of the field operations associated with the MITs were conducted by Golden StrataServices, Inc. (GSS) in conjunction with Gulf Coast Well Analysis. The annular pressure test portion was conducted by GSS and HCC. Field operations were started on October 29, 1990 and concluded on November 2, 1990. The tests on each well included the following:

1. Annulus pressure test.
2. Radioactive tracer survey.

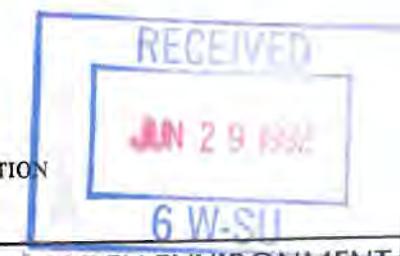
Ambient monitoring was also conducted on WDW-14 and WDW-110.

### MIT RESULTS

The analysis of the well logs demonstrate that no upward migration from the injection zone is occurring and confirms that there are no leaks in the tubing, casing or packer. The RAT checked for upward migration using three separate tests. All three showed no evidence of upward migration. This interpretation was supported on all wells by an independent evaluation performed by Gulf Coast Well Analysis (included in this report).

A demonstration of a leak-free annulus was supported by an annulus pressure test (APT). The annulus of each well was pressurized as follows:

WDW-14 APT- The annulus was pressurized on 10-30-90 to 890 psig and held for one (1) hour. Over this duration a total of five (5) psig was lost. This is well within the Texas Water Commissions's (TWC) criteria for a successful demonstration of mechanical integrity.



WDW-32 APT- The annulus was pressurized on 10-30-90 to 1080 psig and held for thirty minutes. No pressure loss was noted over this duration.

WDW-49 APT- The annulus was pressurized on 10-31-90 to 1,110 psig and held for thirty minutes. Over this duration a total of 22.5 psig was lost. This is within 5% pressure loss criteria established by the TWC for a successful demonstration.

WDW-110 APT- The annulus was pressurized on 10-31-90 to 802 psig and held for one (1) hour. Over this duration a total of two (2) psig was lost. This is well within TWC's criteria for a successful demonstration.



## 2.0 FIELD OPERATIONS SUMMARY

Robert M. Hall of Golden StrataServices, Inc. (GSS) arrived at the Bay City Plant on Monday, October 29, 1990 to begin mechanical integrity testing.

### WDW-14 (WELL NO. 2)

On October 29, 1990 Gulf Coast Well Analysis (GCWA) personnel arrived on location and rigged up their wireline truck and logging equipment to run the radioactive tracer survey (RAT). The radioactive tracer survey was witnessed by Messrs Richard Merritt of the TWC, Robert Hall of GSS, Ray Horton of HCC and Al Laverne of GCWA.

The RAT was performed with the following runs.

1. Ran a baseline gamma-ray log from 3460', plugged back total depth (PBTD), back to 2800'.
2. Run a second baseline gamma-ray log from 3460' back to 2,800'.
3. Ran two five minute statistical checks at 3,430'.
4. Ran two five minute statistical checks at 3,142'.
5. Made a multiple pass survey with a radioactive slug ejected at 3100' and a pump-rate of 40 gpm.
6. Ran a stationary check with the tool held at 3142' and recording on time drive for 40 minutes.
7. Ran after survey baseline gamma ray log (#1) from 3350' to 2880'.
8. Ran after survey baseline gamma ray log (#2) from 3200' to 3000'.
9. Ran after survey baseline gamma ray log (#3) from 3200' to 3000'.
10. Ran after survey baseline gamma ray log (#4) from 3250' to 1500'.

GCWA was rigged down and the well taken out of service in preparation for the annulus pressure test the next afternoon.

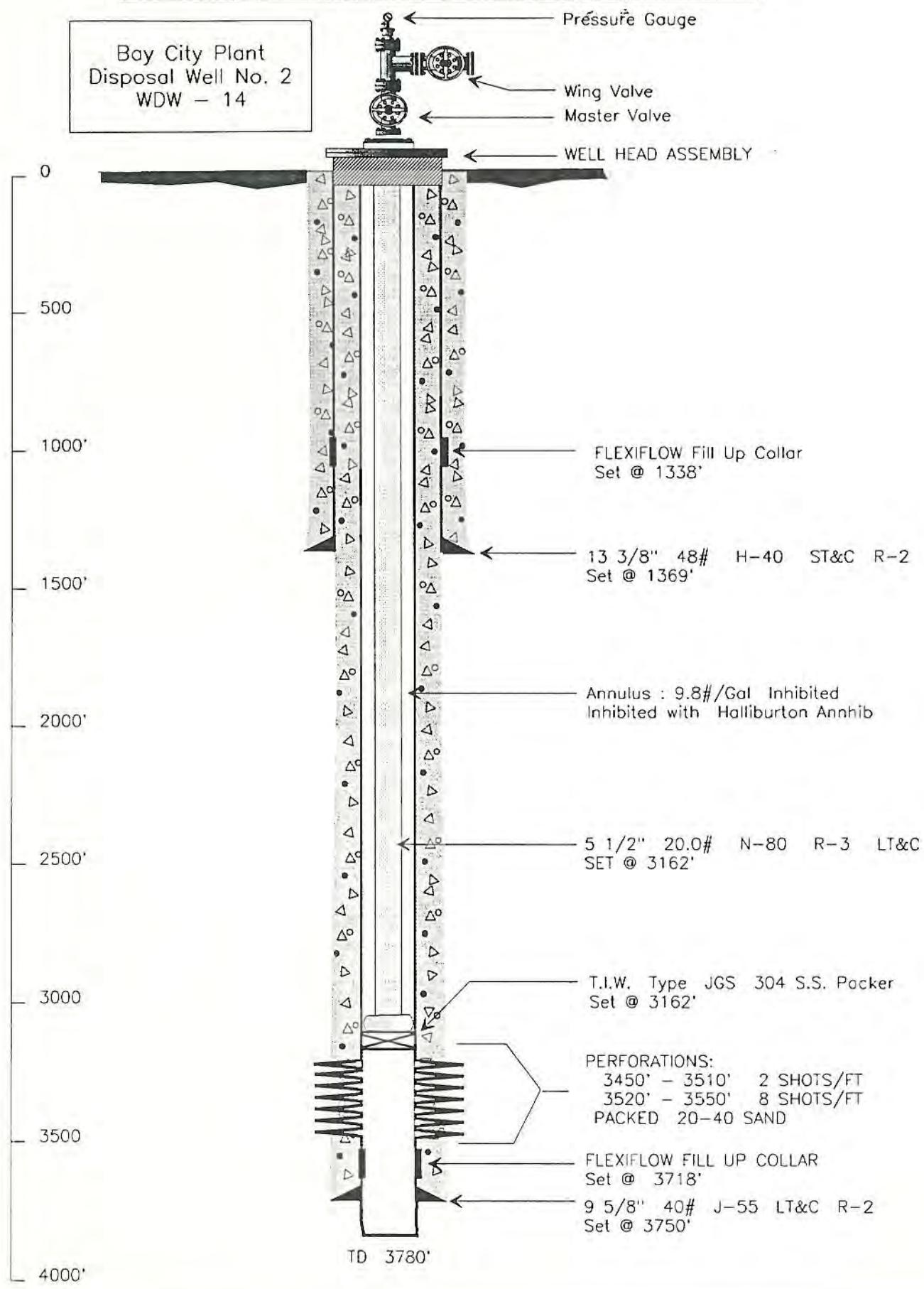
On October 30, 1990 a calibrated pressure recorder was installed on the annulus. The annulus (5+1/2" x 9+5/8" annulus) was pressurized to 890 psig and monitored for one (1) hour. Over this duration a total of five (5) psig was lost.

The annulus pressure test was witnessed by Messrs. Richard Merritt of the TWC, Robert Hall of GSS, Ray Horton of HCC.



# HOECHST CELANESE CHEMICAL GROUP, INC.

Bay City Plant  
Disposal Well No. 2  
WDW - 14



The chart reflecting the recorded pressures is provided in Appendix A.1.

Ambient monitoring was performed on October 29th - 30th. The recap of the ambient monitoring data may be found in Appendix A.2.

WDW-32 (WELL NO. 3)

On October 30, 1990 Gulf Coast Well Analysis (GCWA) personnel arrived on location and rigged up their wireline truck and logging equipment to run the RAT. The RAT was witnessed by Richard Merritt of the TWC, Robert Hall of GSS, Ray Horton of HCC and Al Laverne of GCWA.

The RAT was performed with the following runs.

1. Ran a baseline gamma-ray log from 3380', PBTD, back to 2980'.
2. Run a second baseline gamma-ray log from 3372' back to 2980'.
3. Ran two five minute statistical checks at 3,190'.
4. Made a multiple pass survey with a radioactive slug ejected at 3050' and a pump-rate of 40gpm.
5. Ran a stationary check with the tool held at 3190' and recording on time drive for 40 minutes. Pump rate 120 gpm.
6. Ran final baseline gamma ray log from 3380' to 2940.

GCWA was rigged down and the well placed back into service.

On October 30, 1990 a calibrated pressure recorder was installed on the annulus. The annulus (5+1/2" x 9+5/8" annulus) was pressurized to 1,080 psig and monitored for thirty minutes. No pressure loss was noted during the test. The chart reflecting the recorded pressures is provided in Appendix B.1.

The annulus pressure test was witnessed by Mssrs. Richard Merritt of the TWC, Robert Hall of GSS and Ray Horton of HCC.

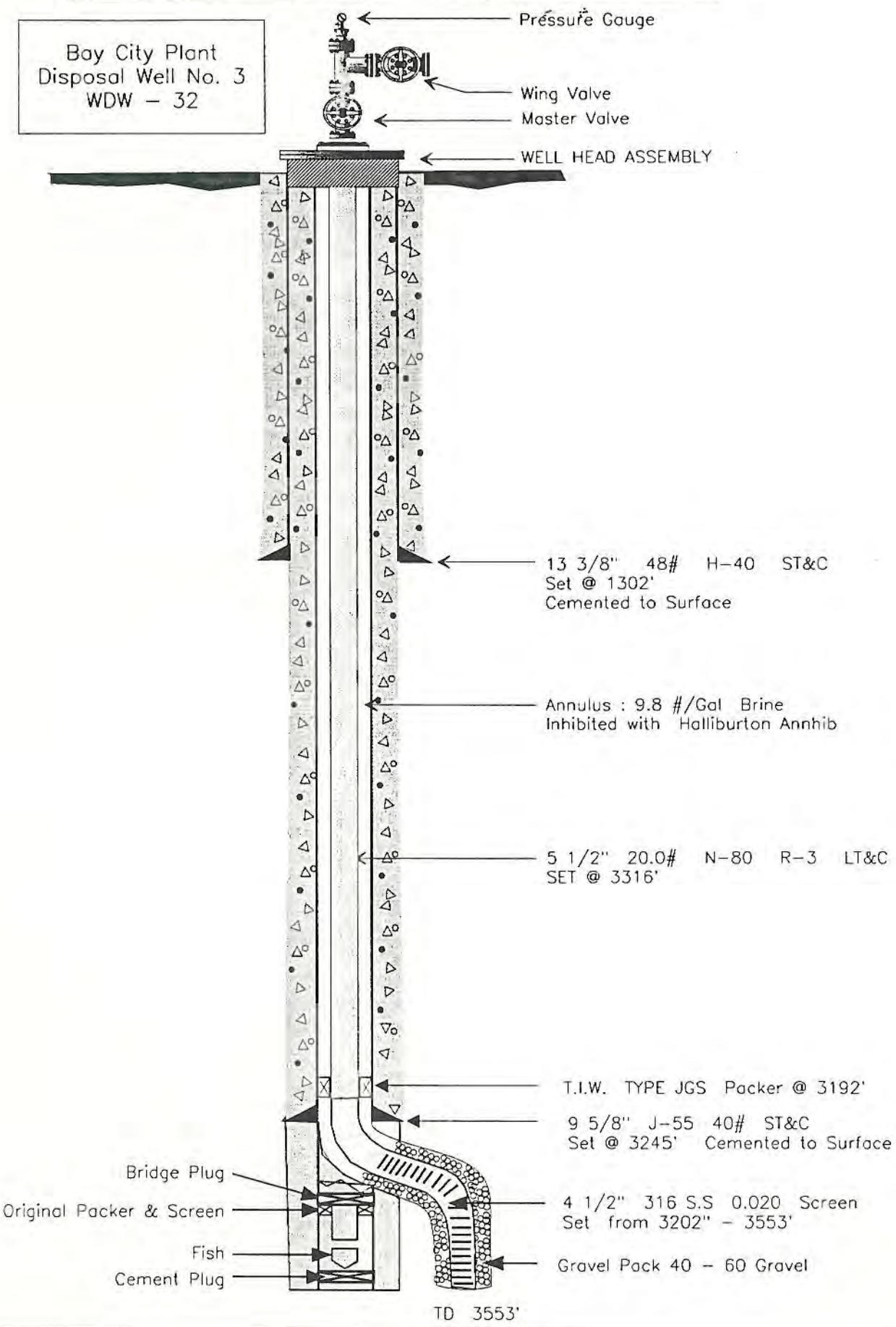
WDW-110 (WELL NO. 1A)

On October 31, 1990 Gulf Coast Well Analysis (GCWA) personnel arrived on location and rigged up their wireline truck and logging equipment to run the radioactive tracer survey (RAT). The radioactive tracer survey was witnessed by



**HOECHST CELANESE CHEMICAL GROUP, INC.**

Bay City Plant  
Disposal Well No. 3  
WDW - 32



Richard Merritt of the TWC, Robert Hall of GSS, Ray Horton of HCC and Al Laverne of GCWA.

The RAT was performed with the following runs.

1. Ran a baseline gamma-ray log from 5650' back to 4750'.
2. Run a second baseline gamma-ray log from 5650' back to 4750'.
3. Ran two five minute statistical checks at 5,616'.
4. Made a multiple pass survey with a radioactive slug ejected at 4930' and a pump-rate of 50gpm.
5. Ran a stationary check with the tool held at 5616' and recording on time drive for 40 minutes.
6. Ran final baseline gamma ray log from 5650' to 4720'.

GCWA was rigged down and the well placed back into service. On October 31, 1990 a calibrated pressure recorder was installed on the annulus. The annulus (5+1/2" x 9+5/8" annulus) was pressurized to 802 psig and monitored for one (1) hour. Over this duration a total of two (2) psig was lost.

The APT was witnessed by MSSRS. Richard Merritt of the TWC, Robert Hall of GSS and Ray Horton of HCC. The chart reflecting the record pressures is provided in Appendix C.1.

Ambient monitoring was performed on October 31st thru November 1st. The recap of the ambient monitoring data may be found in Appendix C.2.

#### WDW-49 (WELL NO. 4)

On November 1, 1990 Gulf Coast Well Analysis (GCWA) personnel arrived on location and rigged up their wireline truck and logging equipment to run the radioactive tracer survey (RAT). The radioactive tracer survey was witnessed by Robert Hall of GSS, Ray Horton of HCC and Al Laverne of GCWA.

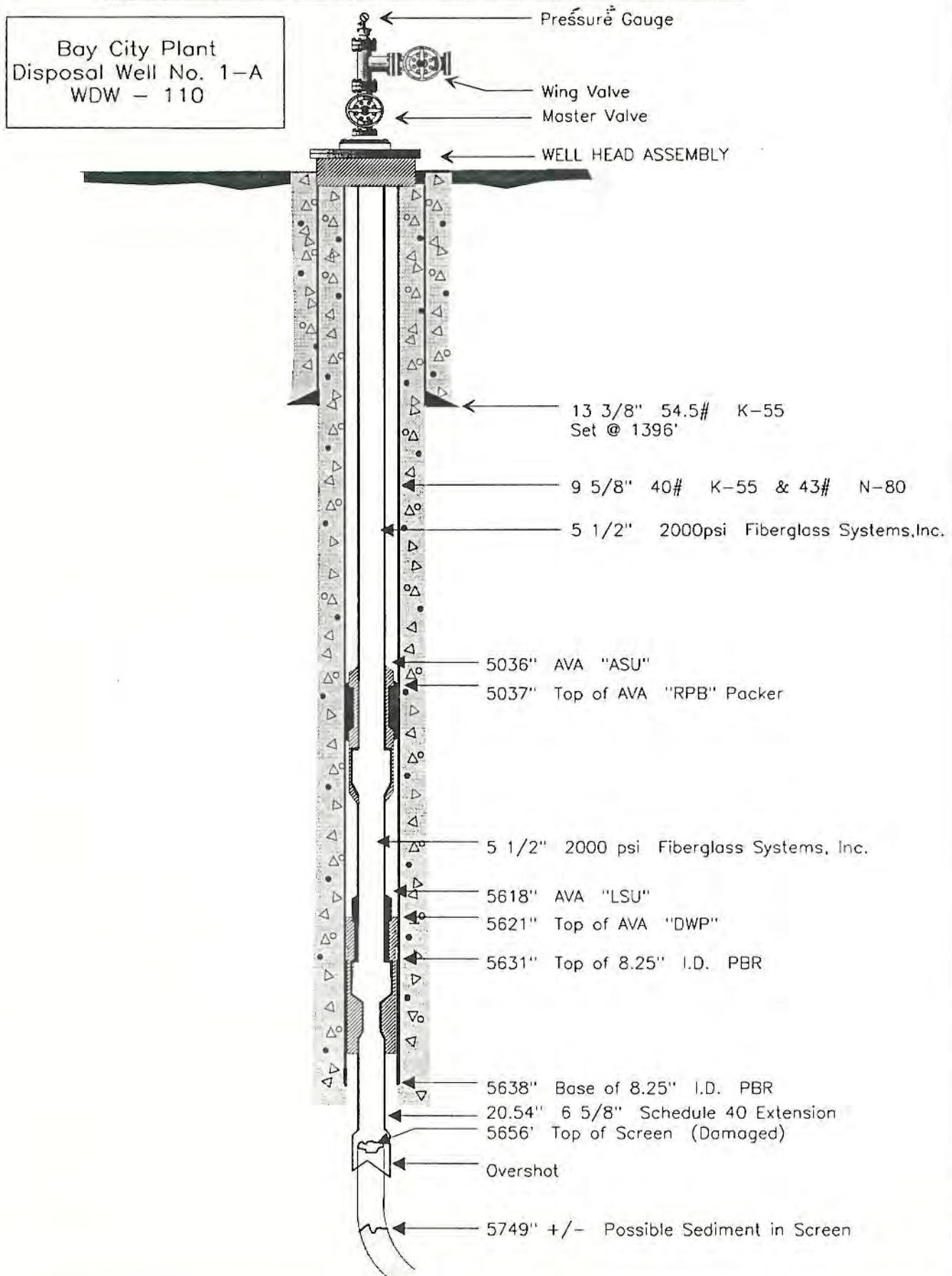
The RAT was performed with the following runs.

1. Ran a baseline gamma-ray log from 3390', PBTD, back to 2980'.
2. Run a second baseline gamma-ray log from 3390' back to 2,980'.
3. Ran two five minute statistical checks at 3,330'.
5. Made a multiple pass survey with a radioactive slug ejected at 3000' and a pump-rate of 60gpm.



**HOECHST CELANESE CHEMICAL GROUP, INC.**

Bay City Plant  
Disposal Well No. 1-A  
WDW - 110



6. Ran a stationary check with the tool held at 3330' and recording on time drive for 40 minutes.
7. Ran final baseline gamma ray log from 3380' to 3000.

GCWA was rigged down and the well placed back into service.

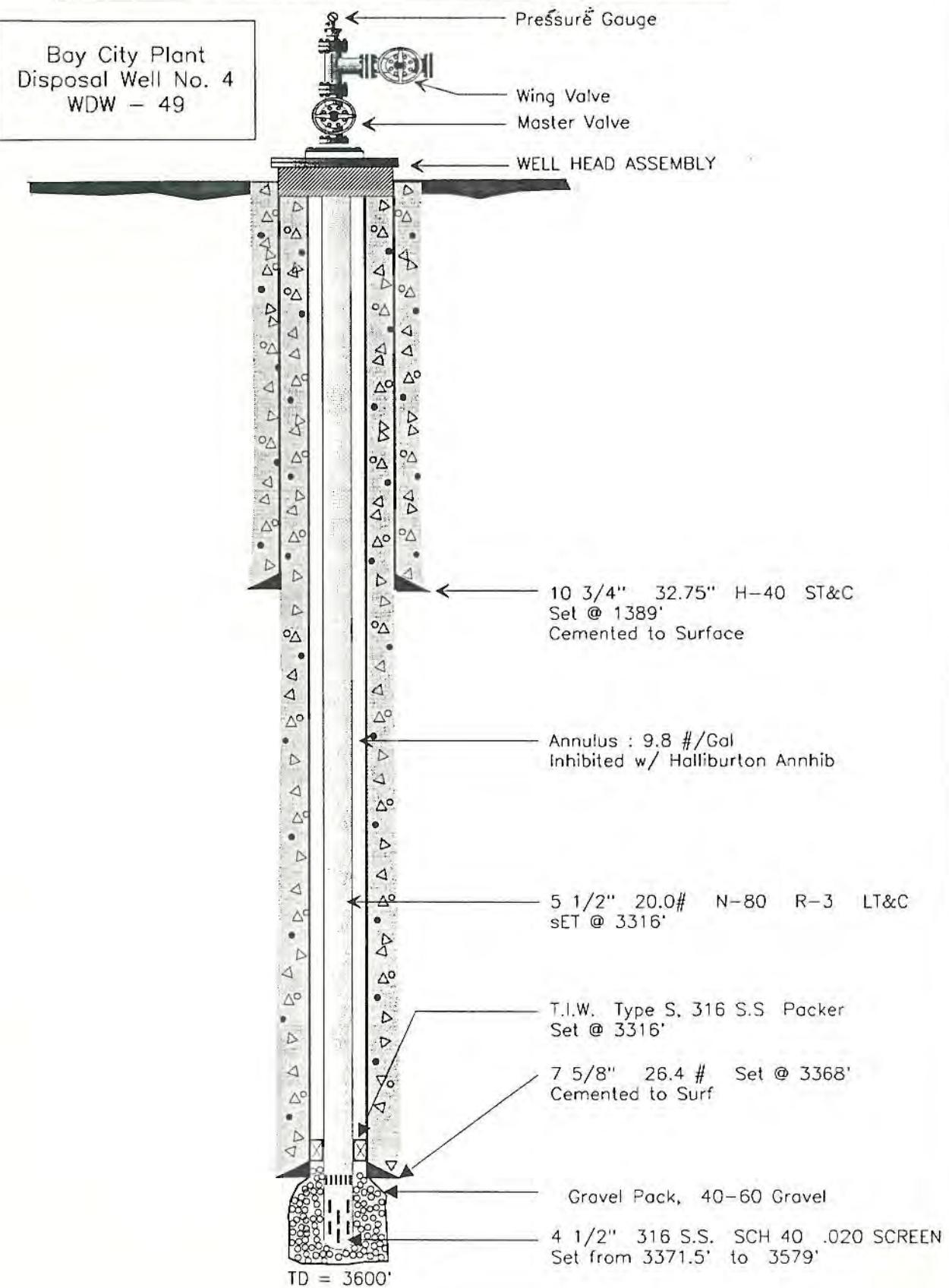
On October 31, 1990 a calibrated pressure recorder was installed on the annulus. The annulus (5+1/2" x 9+5/8" annulus) was pressurized to 1110 psig and monitored for thirty minutes. Over this duration a total pressure loss of 22.5 (5) psig was noted. Maximum allowable pressure loss is 50 psig.

The APT was witnessed by Richard Merritt of the TWC, Robert Hall of GSS and Ray Horton of HCC. The chart reflecting the record pressures is provided in Table D.1.



# HOECHST CELANESE CHEMICAL GROUP, INC.

Bay City Plant  
Disposal Well No. 4  
WDW - 49



## APPENDICES



**APPENDIX A**  
**WASTE DISPOSAL WELL WDW-14**



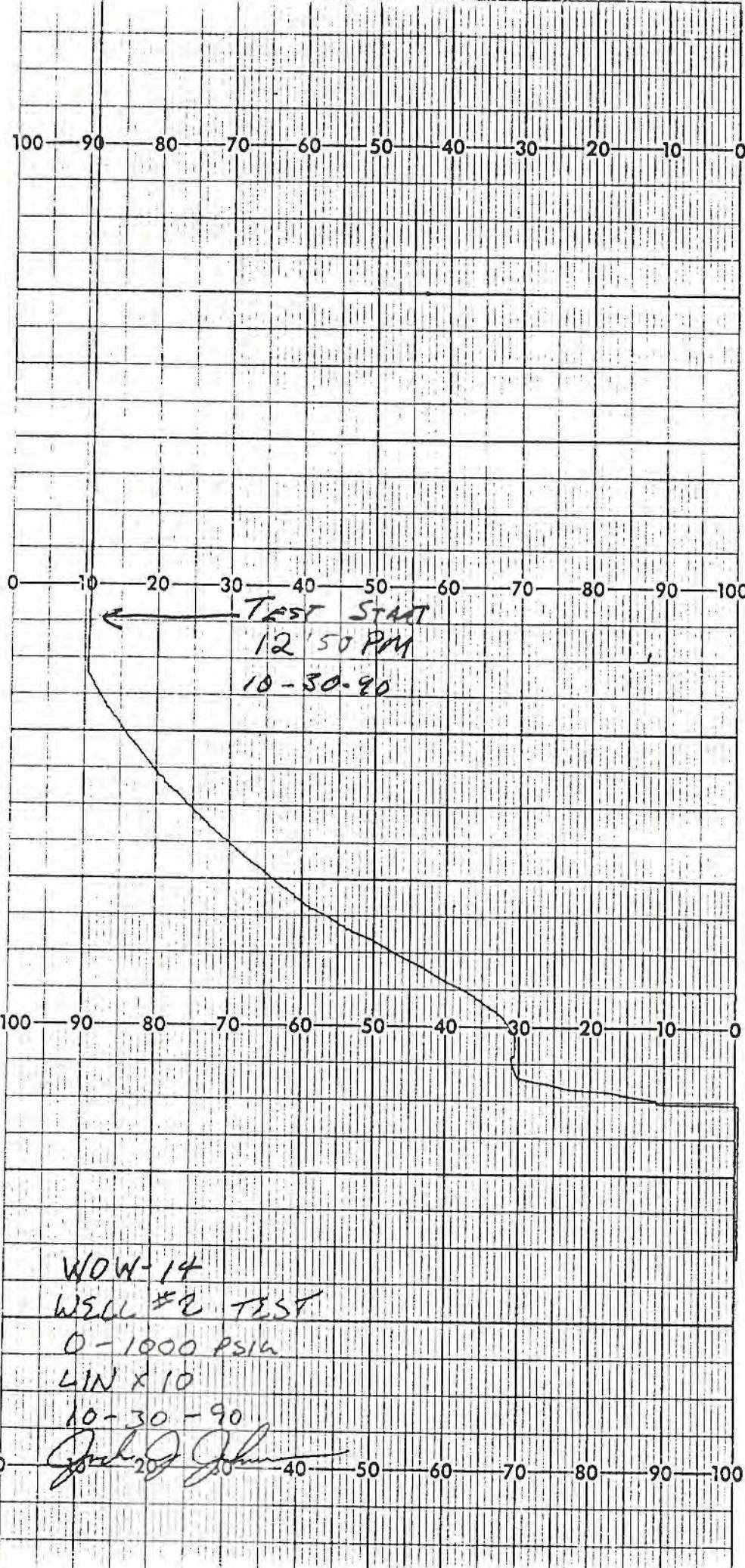
**APPENDIX A.1**

**WDW-14**

**ANNULUS PRESSURE DATA**

**CERTIFICATE OF PRESSURE GAUGE CALIBRATION (ALL WELLS)**

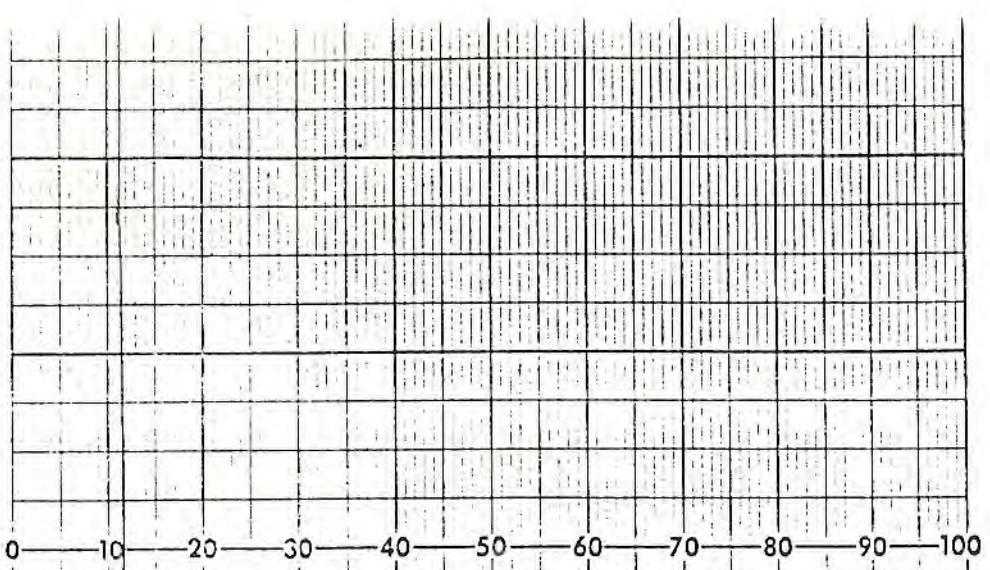




RECORDING CHARTS GRAPHIC CONTROLS CORPORATION BUFFALO, NEW YORK

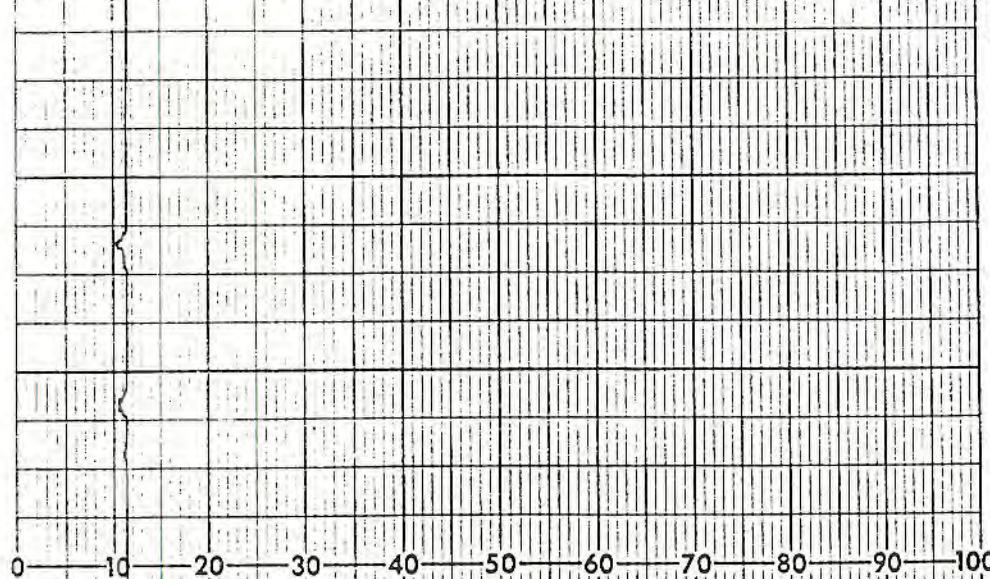
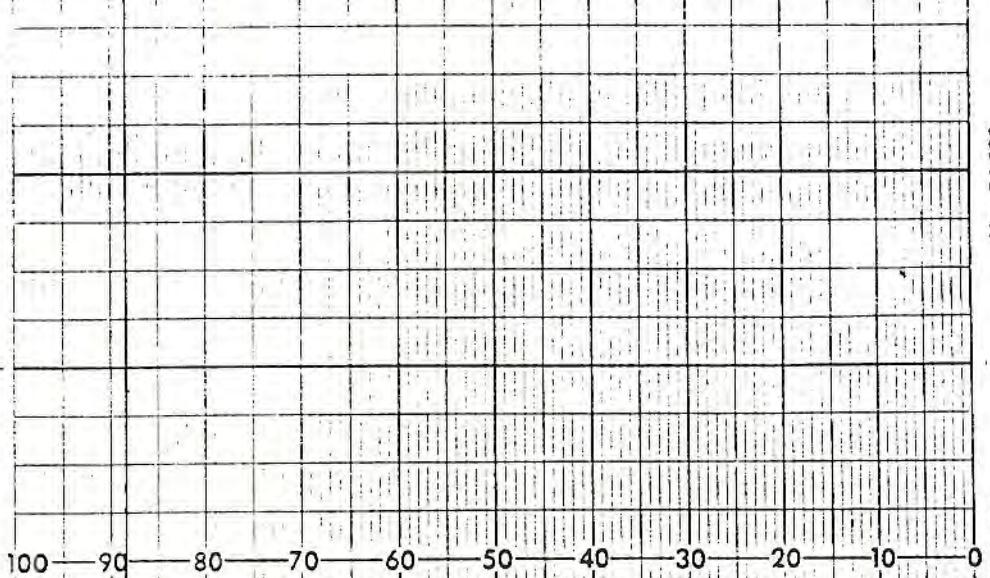
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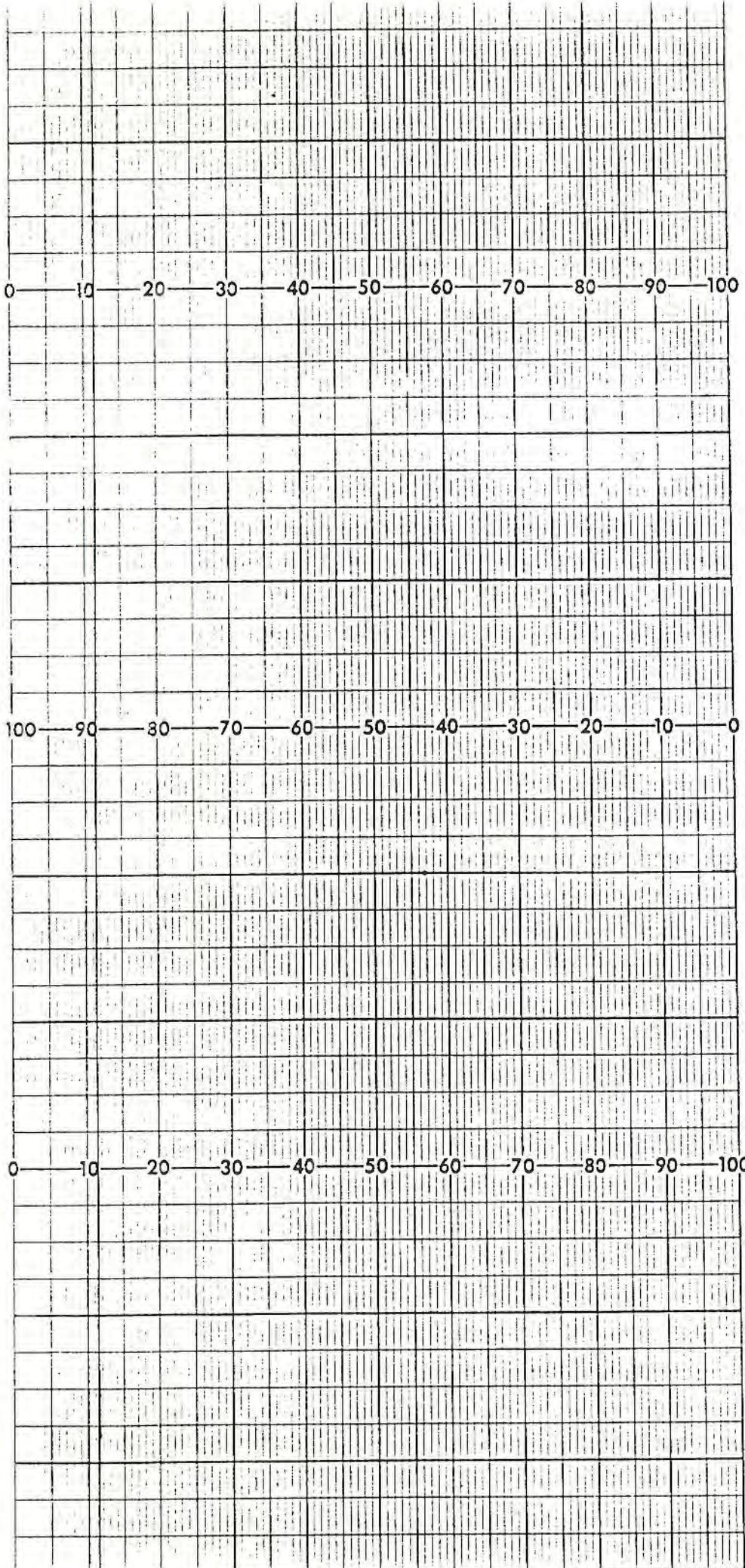


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GI RECORDING CHARTS | GRAPHIC CONTROLS CORPORATION | BUFFALO, NEW YORK

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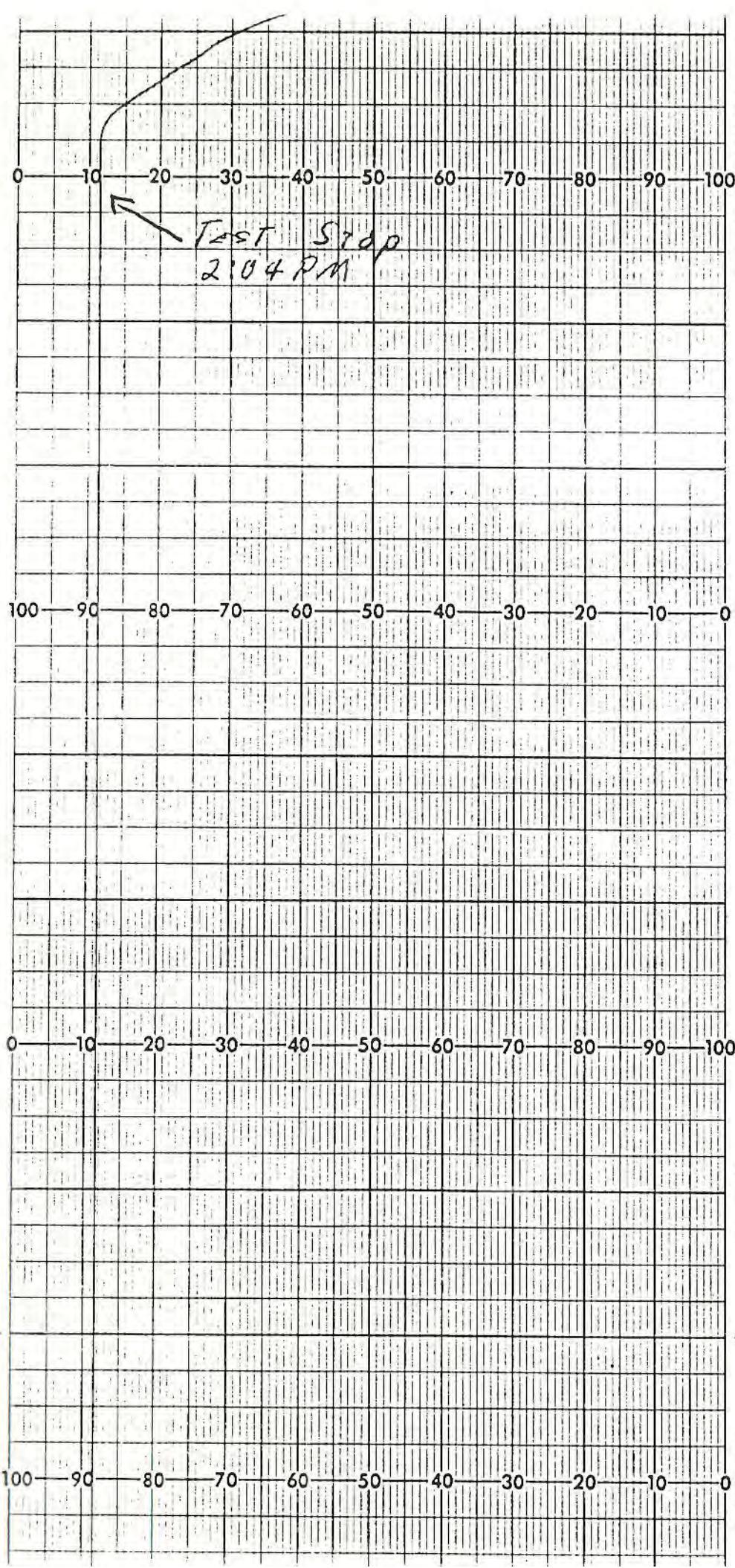
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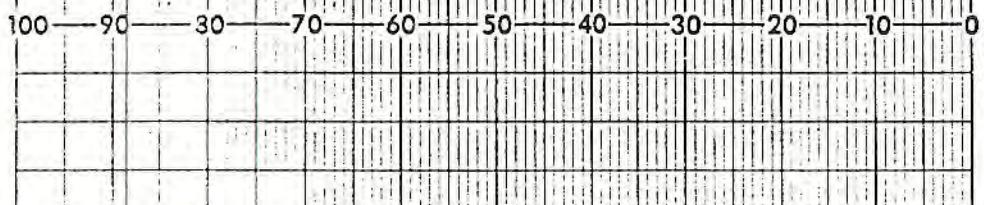
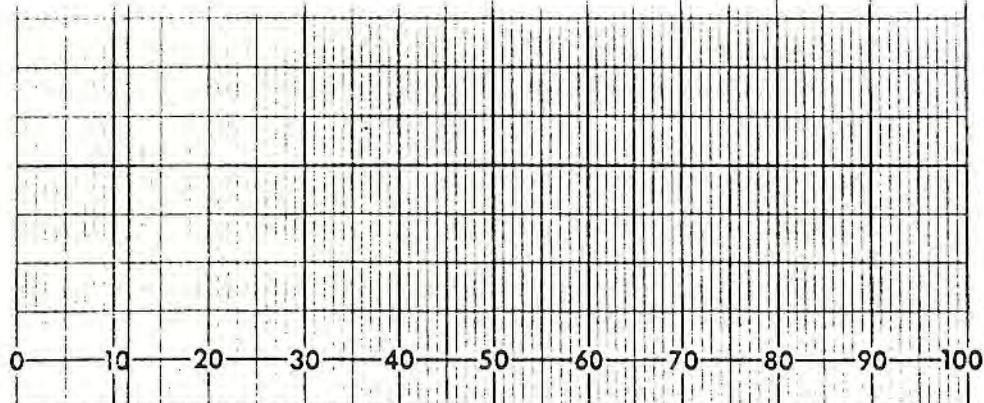
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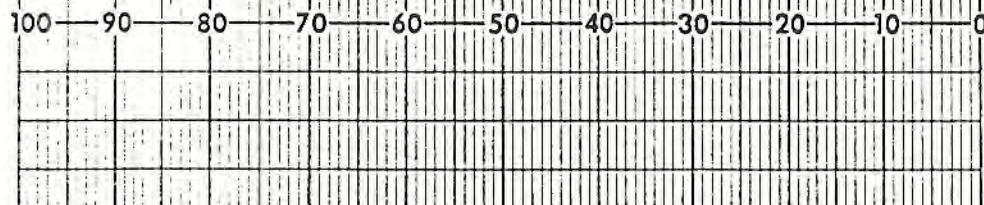


5



CORPORATION

BUFFALO, NEW YORK

*Steph P. Norton**Stocks Balance 10-30-90**B. J. D.**Salem Books 10-30-90*

CORPORATION

BUFFALO, NEW YORK

WOW~14



**GOLDEN ENVIRONMENTAL SERVICES, INC.**  
AFFILIATE OF GOLDEN STRATASERVICES, INC.

Date: October 9, 1990

To: ~~H. R. Horton~~

From: J. J. Johnson

Dept/Location: Bay City Plant

Dept/Location: Maintenance  
JJJ-407-M-90Subject: Well Test Equipment Certification

On October 8, 1990, the equipment that will be used to test the well facilities was run through a calibration check. The equipment was set up as it will be used during the well tests. The check was to insure the calibration and accuracy of the transmitter and recorder. The pressure ranged from zero pounds per square inch gauge to 1000 pounds per square inch gauge. The transmitter put out a four to twenty millamp signal, which was received by the recorder through a 250 OHM dropping resistor. The results are documented on following pages.

On October 9, 1990, the equipment, in the same manner, was run through a second test. The range was zero pounds per square inch gauge to 1500 pounds per square inch gauge. The results are documented on following pages.

The equipment consists of:

1. Honeywell ST3000 Smart Transmitter Model #STG 170-E1G-00000-MB,  
FIC3-3138
2. Strip Recorder
3. 24 Volt Power Supply
4. Eaton Model UPC 5000 Pressure Calibrator, Serial No. A1258. See attached  
certificate of calibration.



J. J. Johnson

lrk

Attachments

File: 6.5.0.0-M

0 - 1000 PSIG Test  
October 8, 1990

Transmitter Input PSIG	Transmitter Output Current	Recorder Chart %
0 PSIG	4.00 mA	0%
100 PSIG	5.59 mA	10%
200 PSIG	7.19 mA	20%
300 PSIG	8.78 mA	30%
400 PSIG	10.37 mA	40%
500 PSIG	11.99 mA	50%
600 PSIG	13.60 mA	60%
700 PSIG	15.20 mA	70%
800 PSIG	16.80 mA	80%
900 PSIG	18.41 mA	90%
1000 PSIG	20.00 mA	100%

0 - 1500 PSIG Test  
October 9, 1990

Transmitter Input PSIG	Transmitter Output Current	Recorder Chart %
0 PSIG	4.00 mA	0%
150 PSIG	5.59 mA	10%
300 PSIG	7.19 mA	20%
450 PSIG	8.80 mA	30%
600 PSIG	10.40 mA	40%
750 PSIG	12.00 mA	50%
900 PSIG	13.61 mA	60%
1050 PSIG	15.21 mA	70%
1200 PSIG	16.81 mA	80%
1350 PSIG	18.41 mA	90%
1500 PSIG	20.01 mA	100%

**Consolidated Controls**



Eaton Corporation  
Defense Pressure Sensors  
Division  
15 Durant Avenue  
Bethel, Connecticut 06801  
(203) 743-6721

### CERTIFICATION OF CALIBRATION

Type UPC 5000 BACK      Digital Indicator

Serial No. A1258      Range 2000/1000/400 PSI

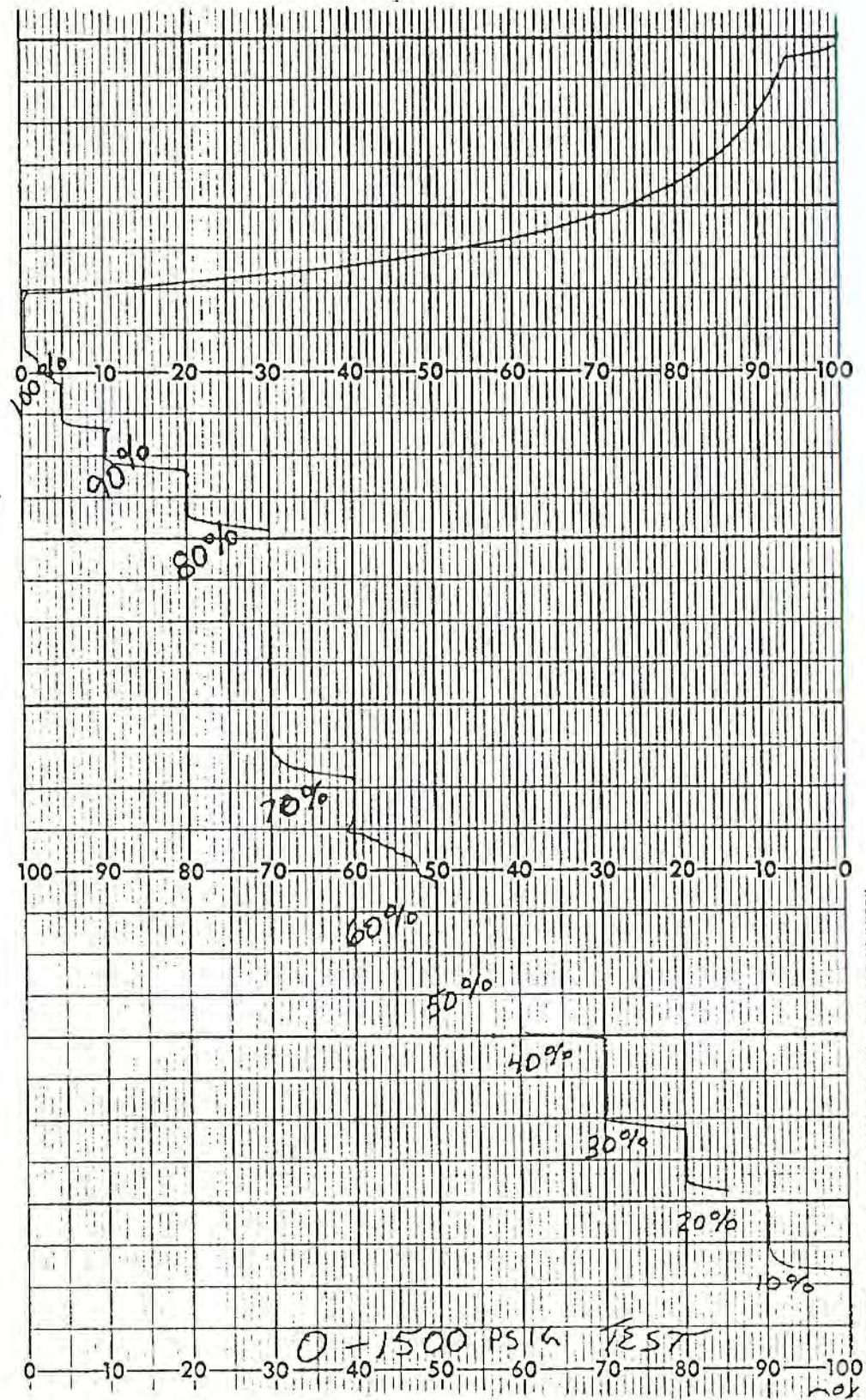
P. O. III2589      Date May 22, 1989

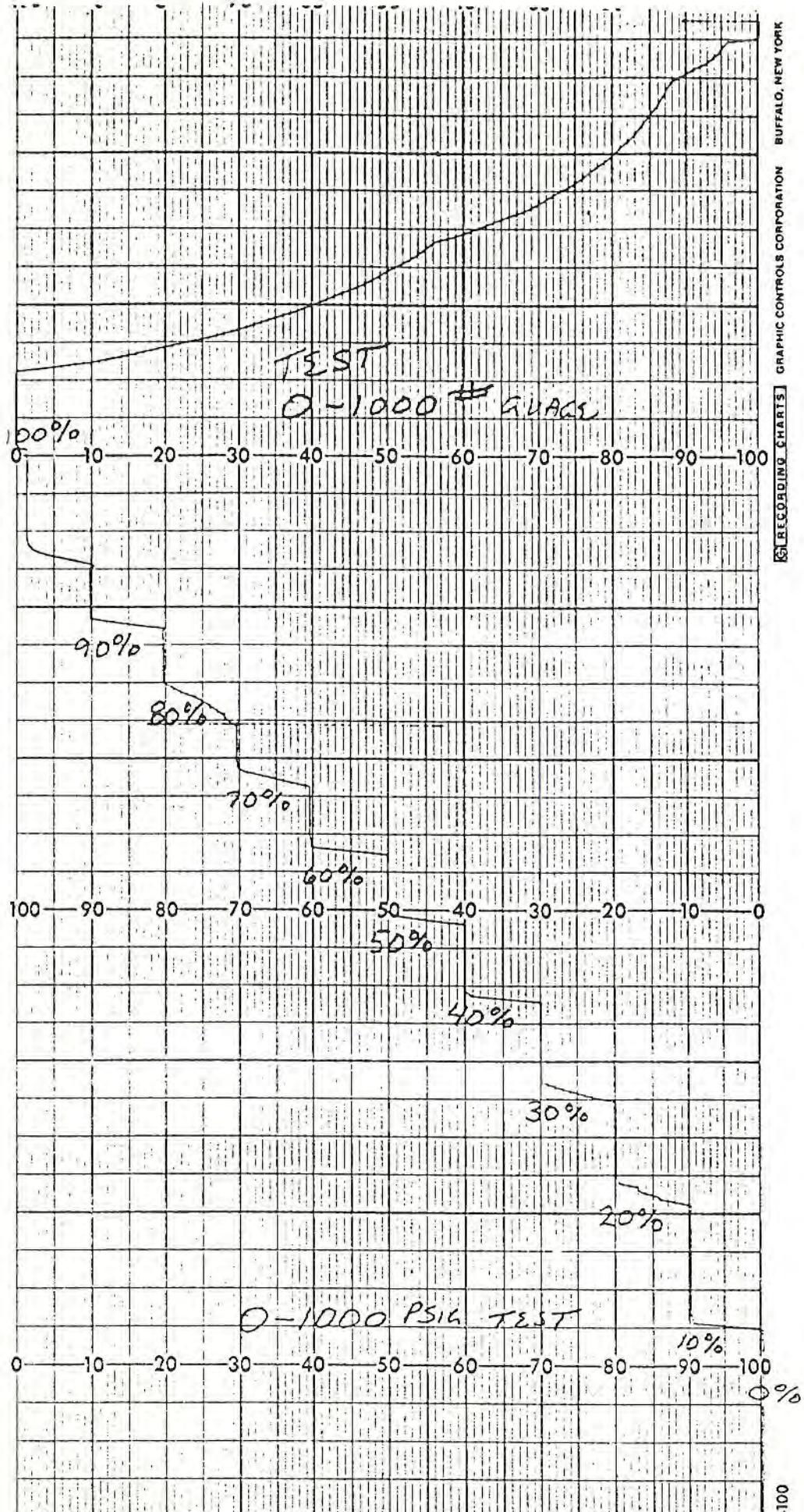
THIS IS TO CERTIFY THAT THE INSTRUMENT IDENTIFIED ABOVE HAS BEEN CALIBRATED AGAINST STANDARDS MAINTAINED BY CONSOLIDATED CONTROLS CORPORATION. THE ACCURACY OF THESE STANDARDS IS DIRECTLY TRACEABLE TO THE NATIONAL STANDARDS AT THE NATIONAL BUREAU OF STANDARDS.

THE INSTRUMENT PERFORMS SATISFACTORILY AND ITS ACCURACY IS WITHIN  $\pm 0.05\%$  F.S. AS ORIGINALLY SPECIFIED. CALIBRATION WAS PERFORMED AT A TEMPERATURE OF

78 °F.

Certified By Stephanie Koenig  
CONSOLIDATED CONTROLS





BUFFALO, NEW YORK

GRAPHIC CONTROLS CORPORATION

RECORDING CHARTS

-100

**APPENDIX A.2**  
**WDW-14**  
**RADIOACTIVE TRACER SURVEY**



## Gulf Coast Well Analysis

RADIOACTIVE TRACER SURVEY

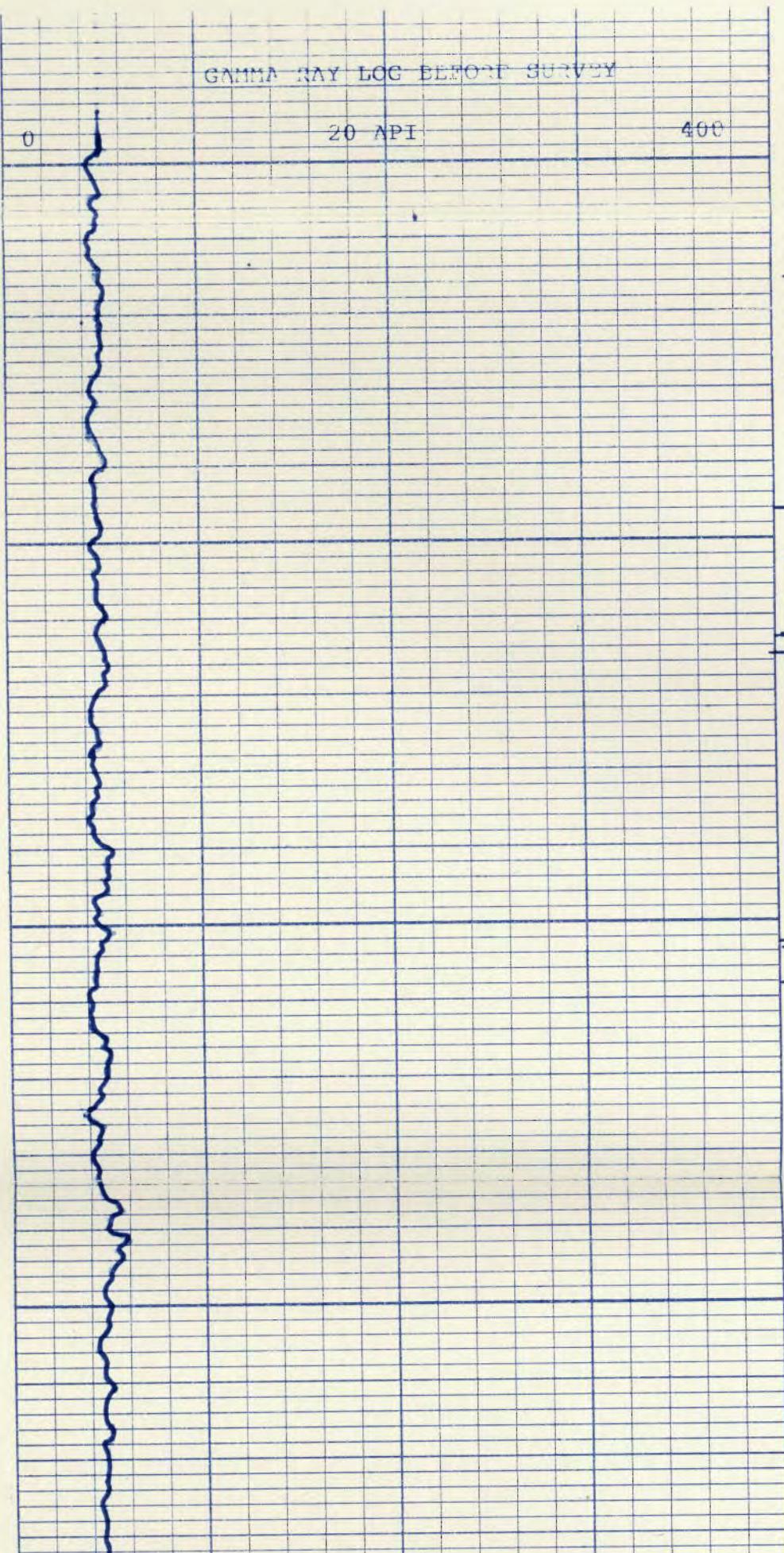
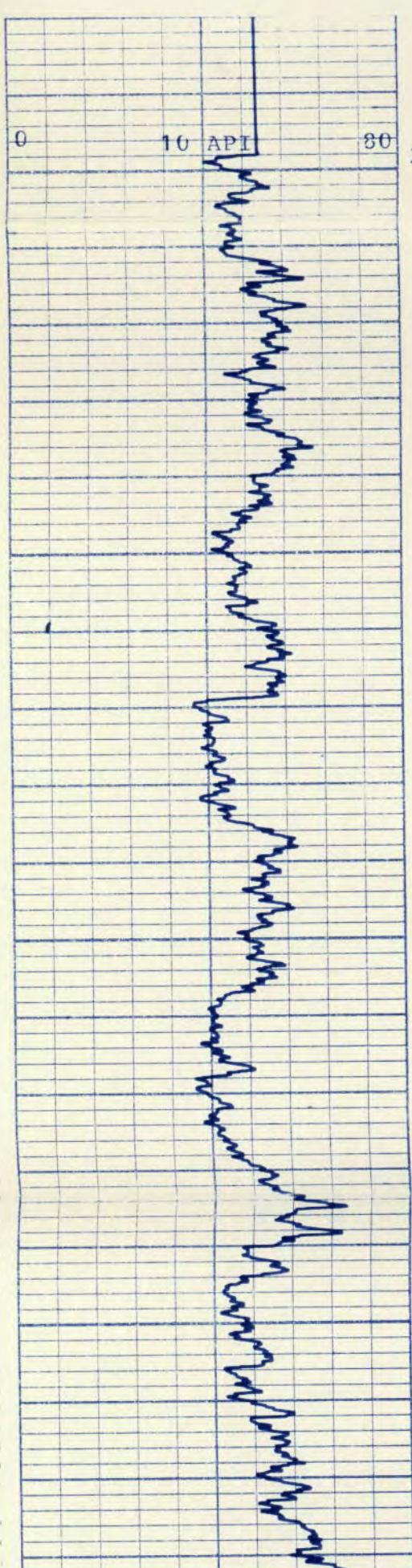
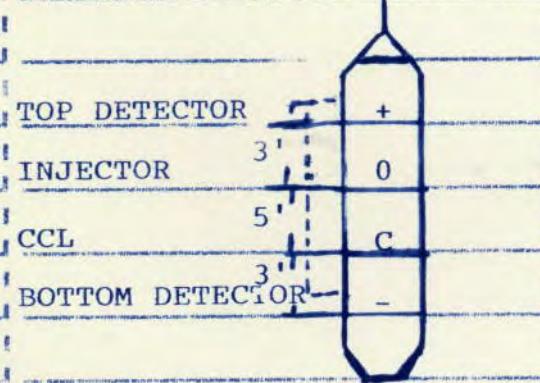
**NOTICE:** All interpretations are opinions based on inferences from electrical or other measurements and we cannot, and do not, guarantee the accuracy or correctness of any interpretations, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages or expenses incurred or sustained by anyone resulting from any interpretation made by one of our officers, agents or employees. These interpretations are also subject to our General Terms and Conditions as set out in our current Price Schedule.

Gulf Coast Well Analysis

RADIOACTIVE TRACER LOG SUMMARY SHEET

Rund	Time	Depth	Rate	TC	Description
1	15:15	15:40	2800	3460	STATIC GAMMA RAY LOG BEFORE SURVEY
2	15:50	16:10	2800	3350	STATIC GAMMA RAY LOG BEFORE SURVEY
3	16:45	16:50		3430	STATIC STATISTICAL CHECK @ 3430'
4	16:50	16:55		3430	STATIC STATISTICAL CHECK @ 3430'
5	16:25	16:30		3142	STATIC STATISTICAL CHECK @ 3142'
6	16:30	16:35		3142	STATIC STATISTICAL CHECK @ 3142'
7		17:00		3100	40 GPM INJECTED 5 SEC. 10 MCI.
8		17:04		3180	40 GPM PASS #1 PEAK @ 3180'
9		17:06		3196	40 GPM PASS #2 PEAK @ 3196'
10		17:09		3222	40 GPM PASS #3 PEAK @ 3222'
11		17:14		3260	40 GPM PASS #4 PEAK @ 3260'
12		17:20		3304	40 GPM PASS #5 PEAK @ 3304'
13	17:25	18:05		80 GPM	STATIONARY PACKER CK. 3142
14	18:10	18:30	2880	3350	80 GPM GAMMA RAY LOG AFTER SURVEY
15	18:30	18:45	3000	3200	80 GPM AFTER SURVEY G/R REPEAT 2

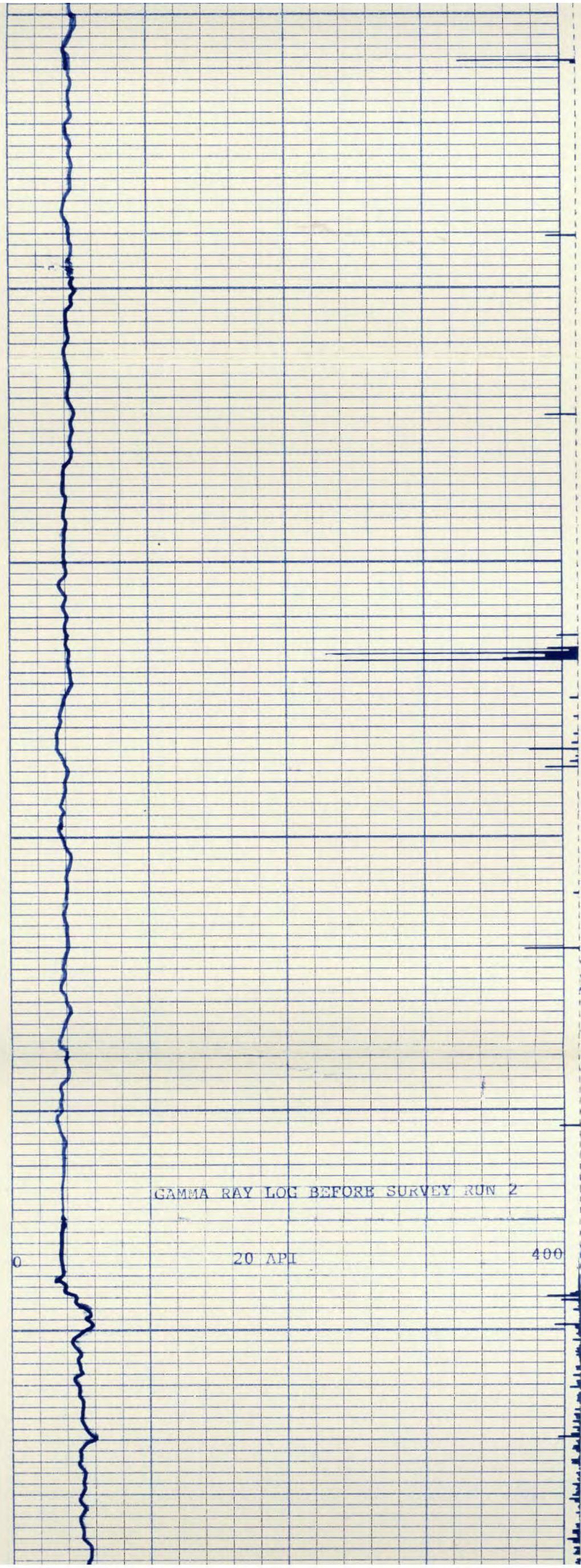
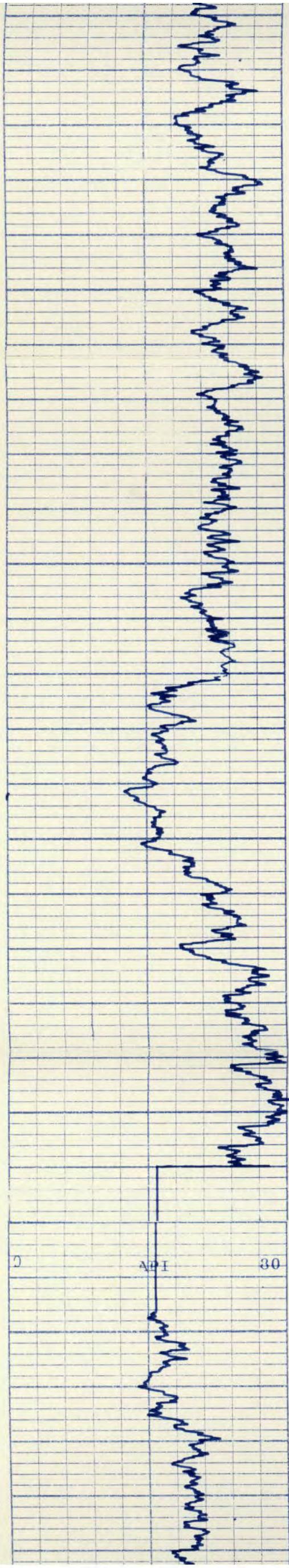
14	18:10	18:30	2880	3350	80	GPM	3	GAMMA RAY LOG AFTER SURVEY 1
15	18:30	18:45	3000	3200	80	GPM	3	AFTER SURVEY G/R REPEAT 2
16	18:45	19:00	3000	3200	80	GPM	3	AFTER SURVEY G/R REPEAT 3
17	19:05	19:30	1500	3250	80	GPM	3	GAMMA RAY LOG AFTER SURVEY 4

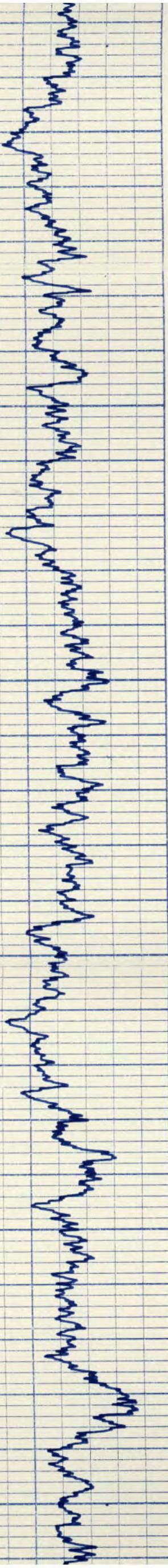


3000

3100

3200

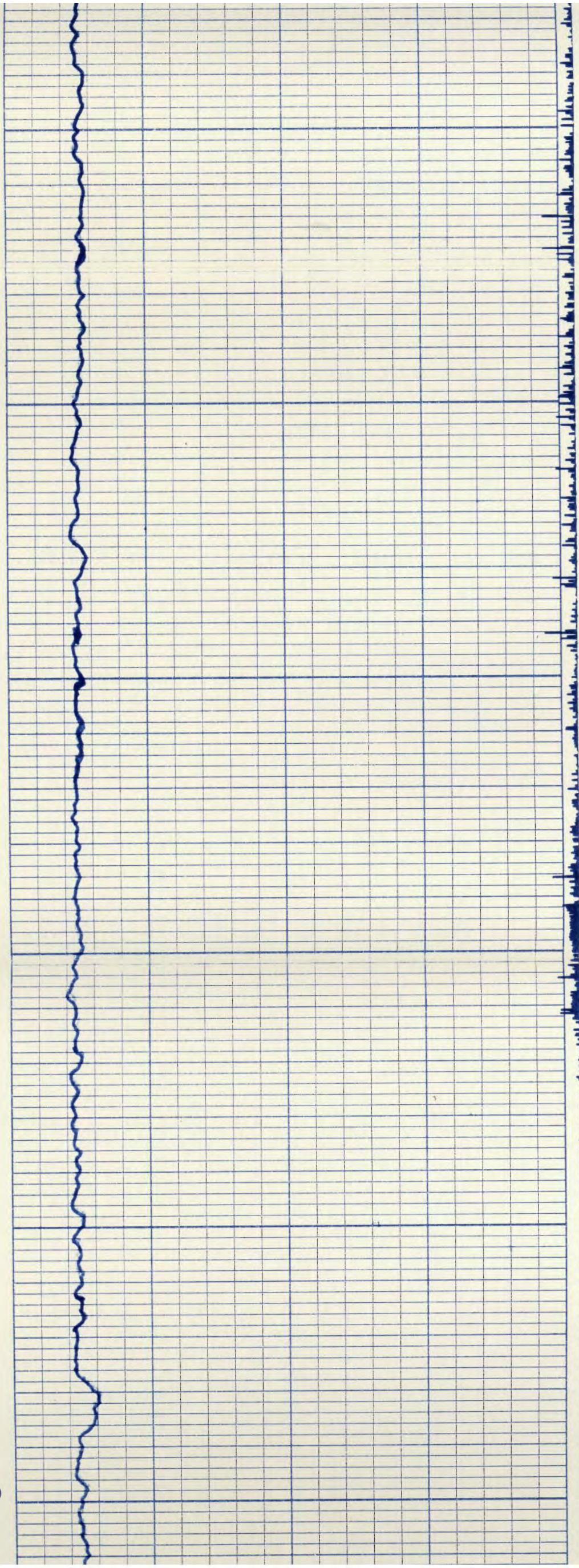




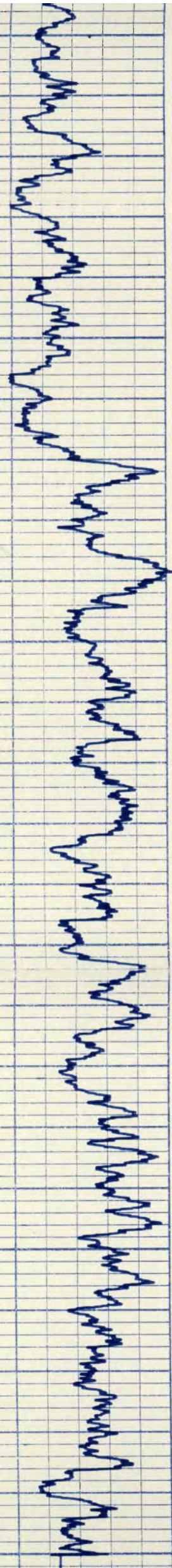
2900

3000

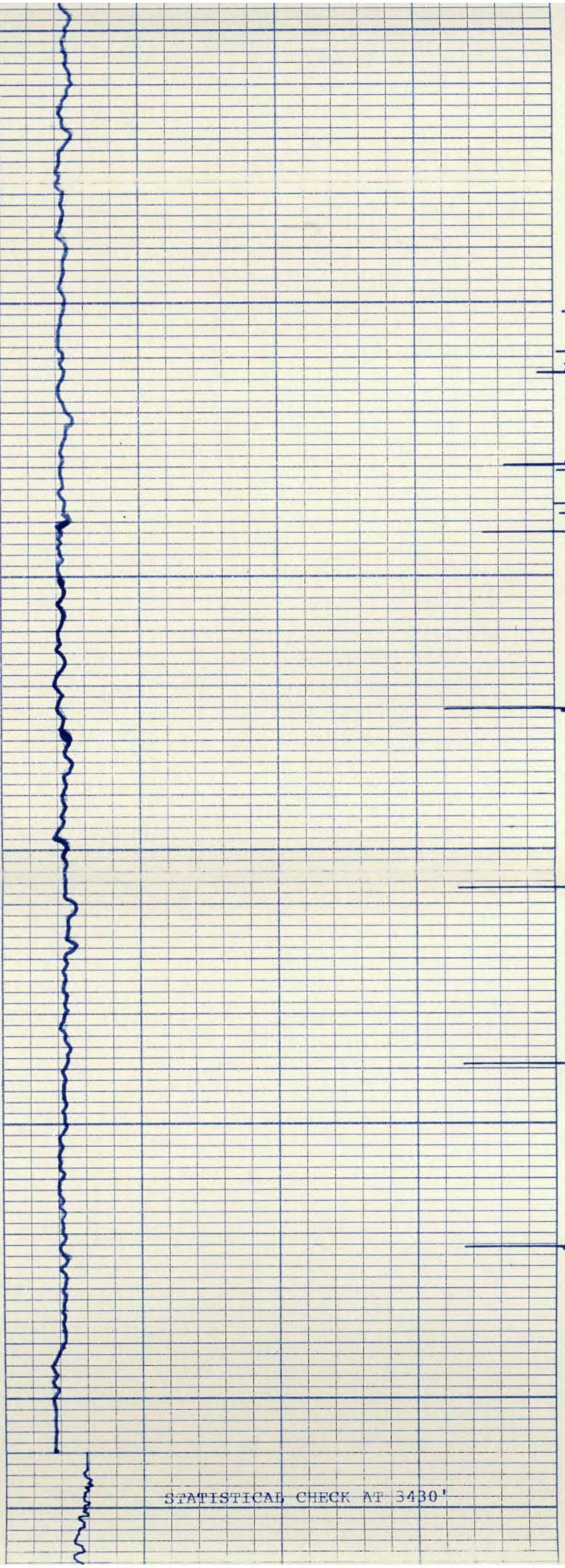
3100



3100



3200

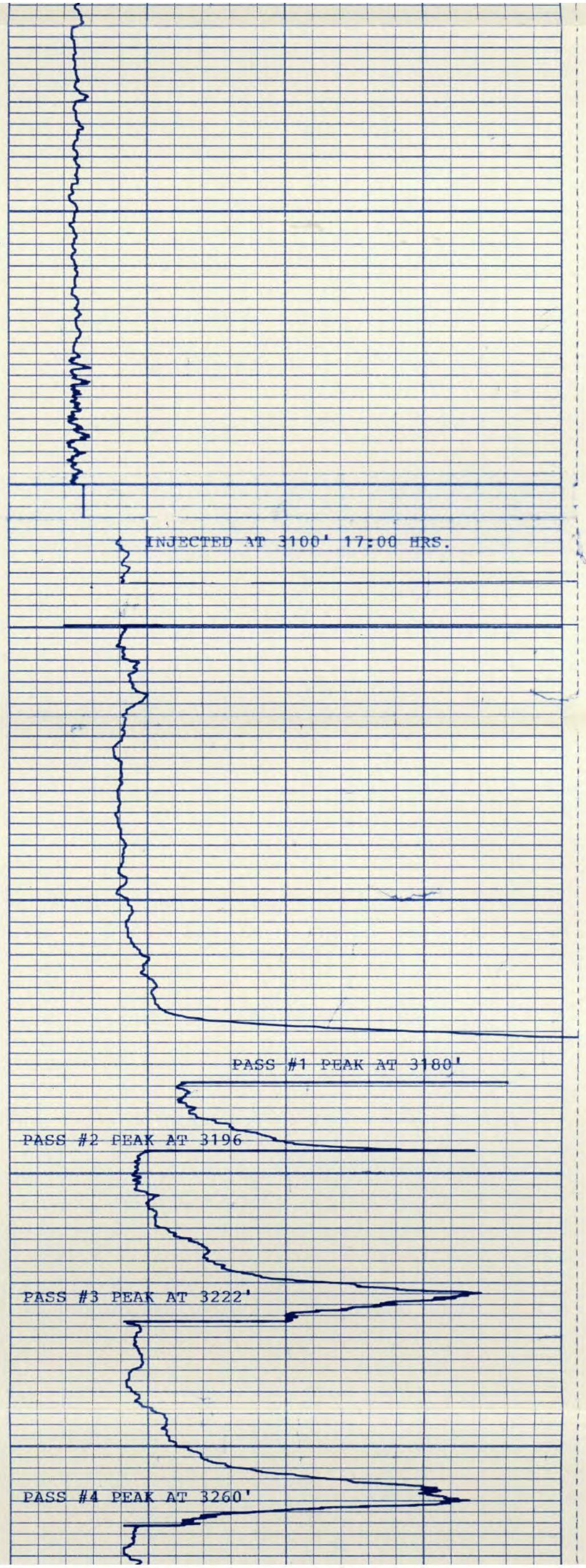


3300

STATISTICAL CHECK AT 3430'

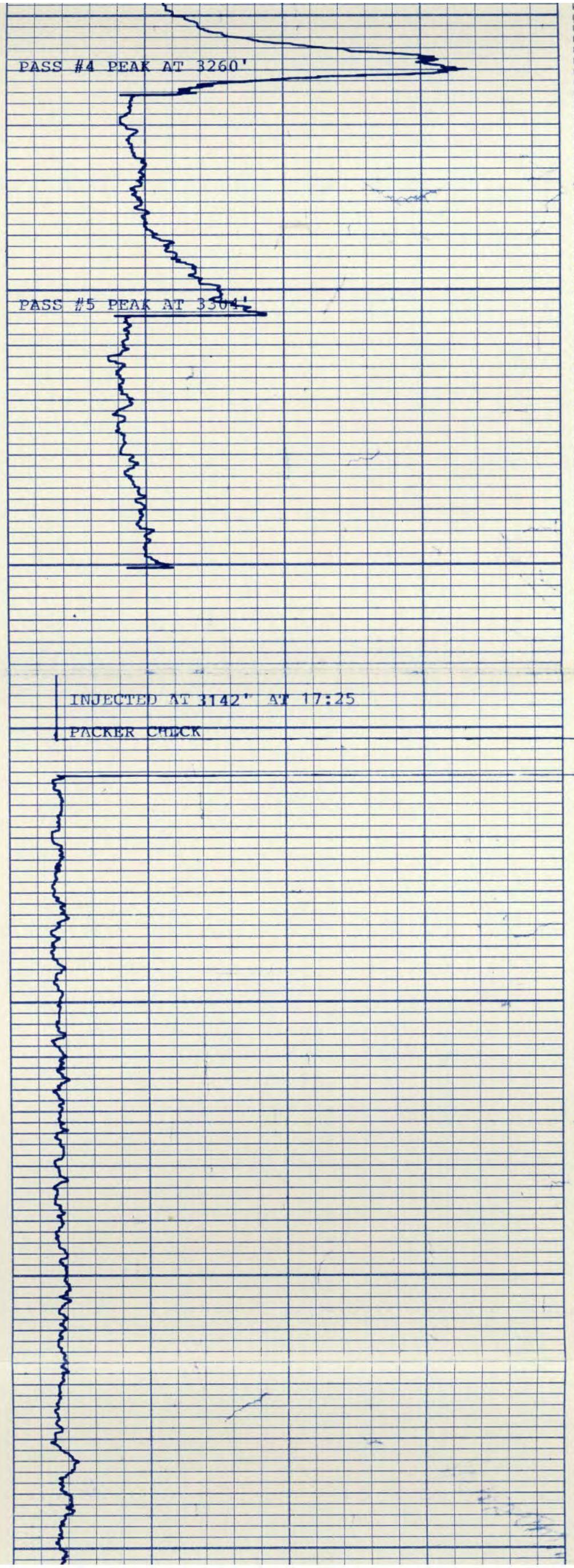
STATISTICAL CHECK AT 3430'

STATISTICAL CHECK AT 3430'



3100

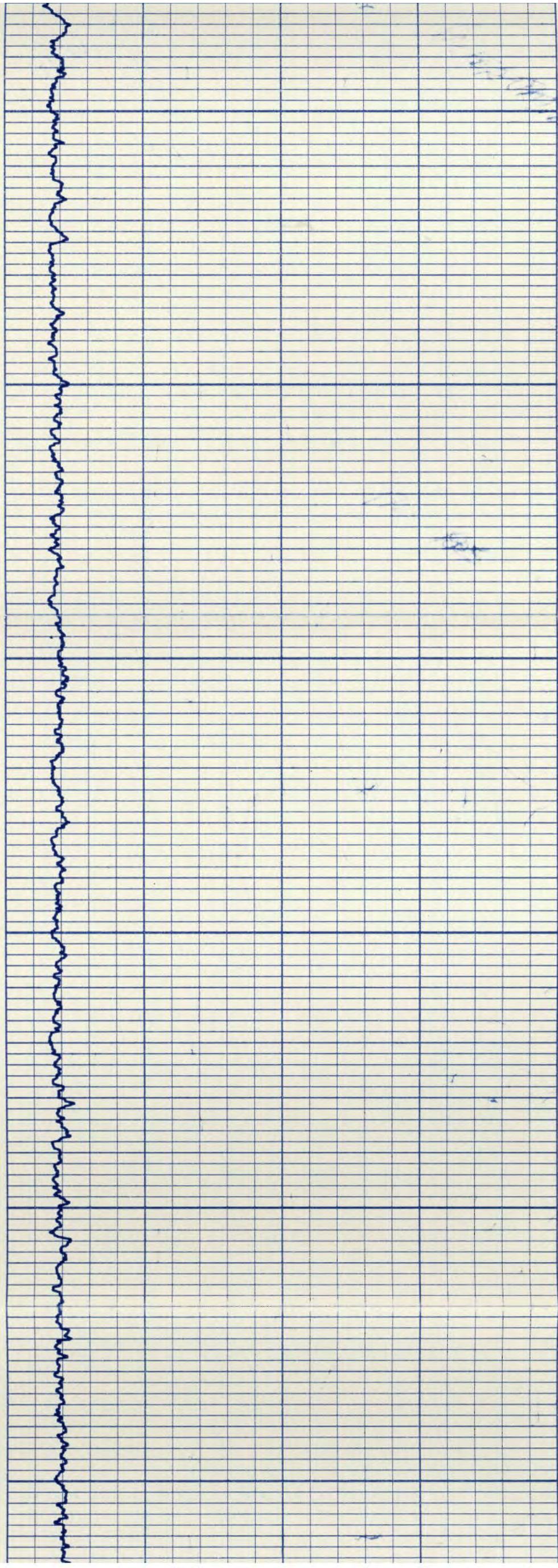
3200



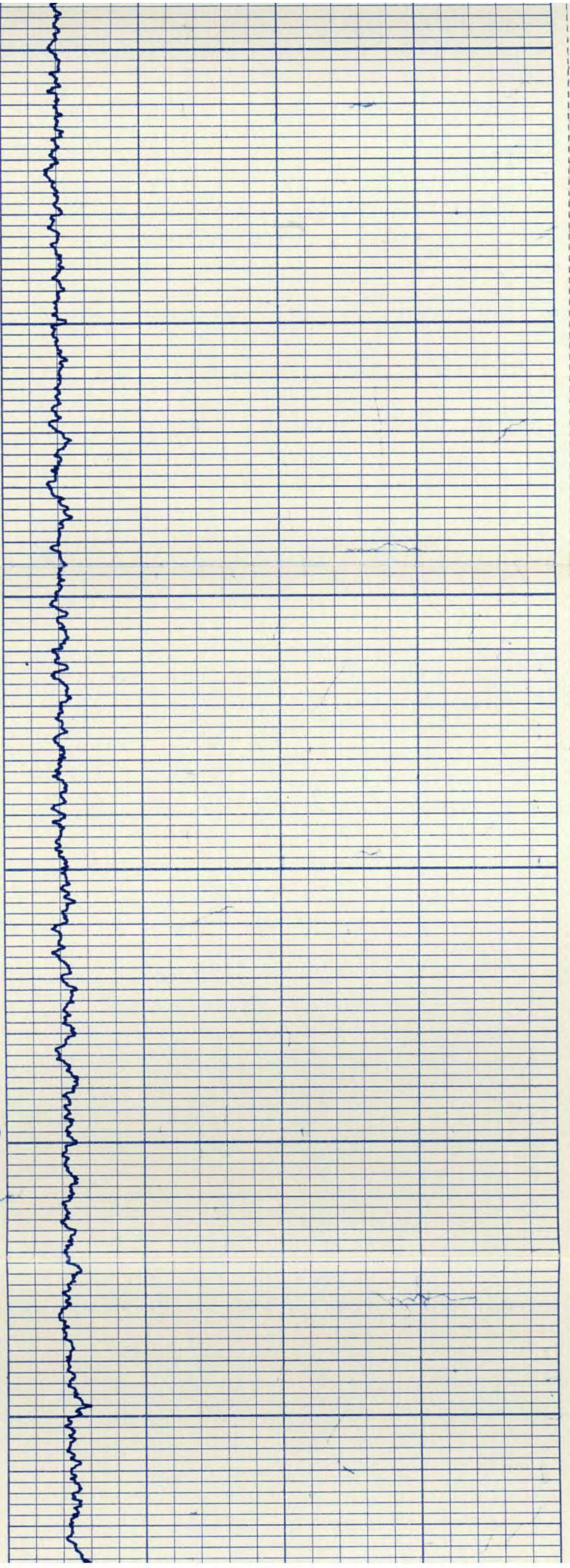
17:40

17:45

17:50

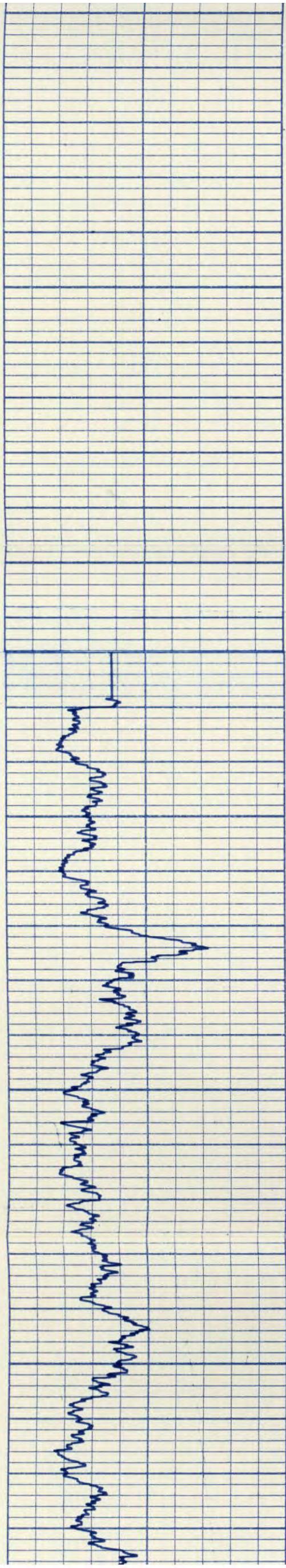


17:50



17:55

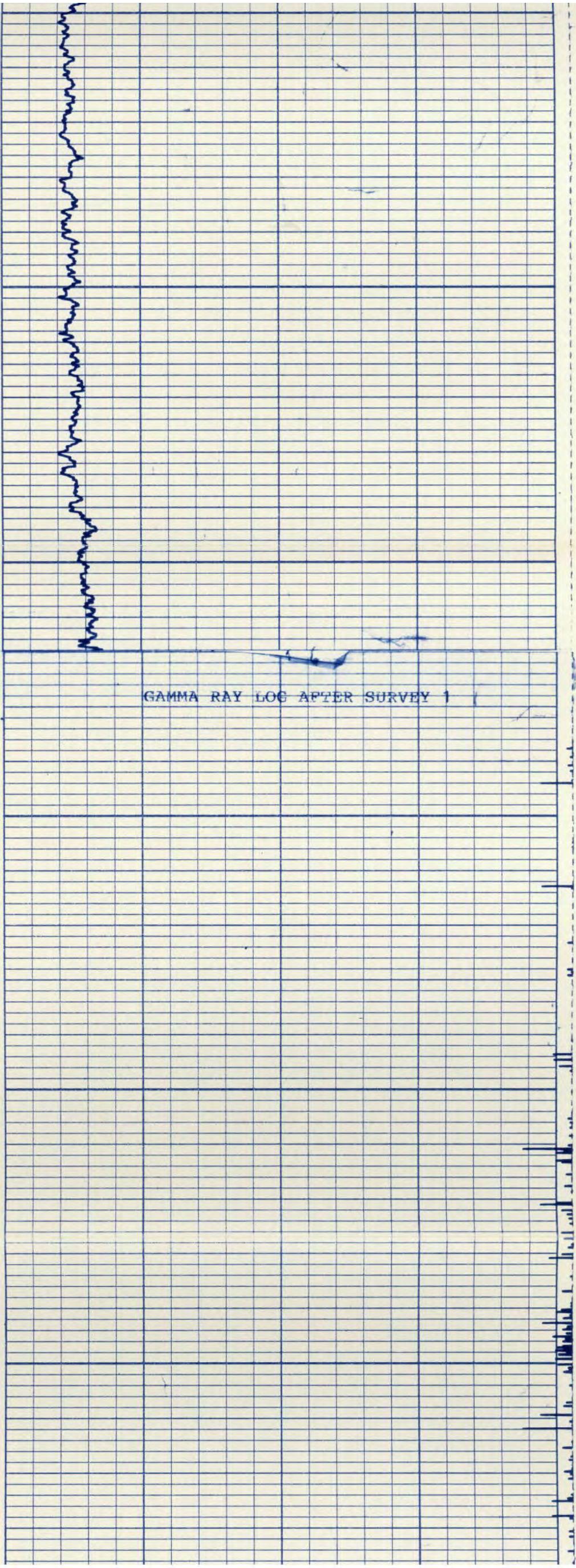
18:00

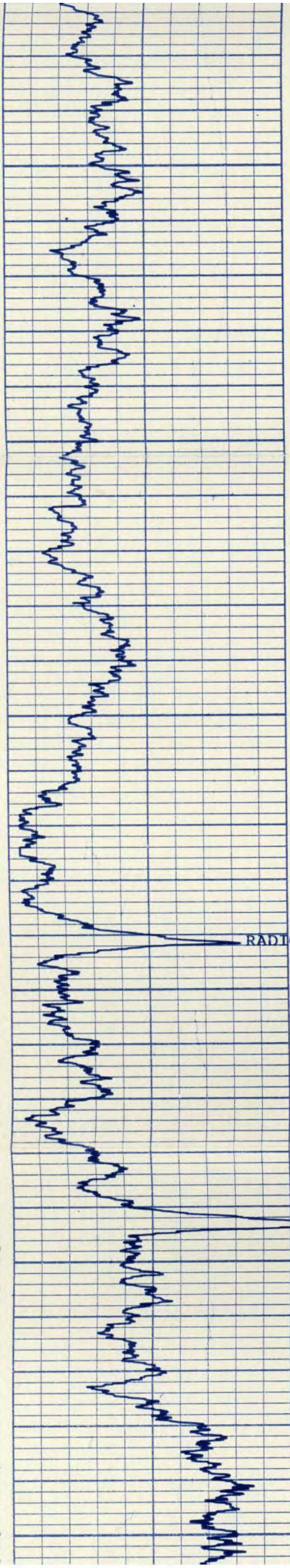


18:05

2800

2900





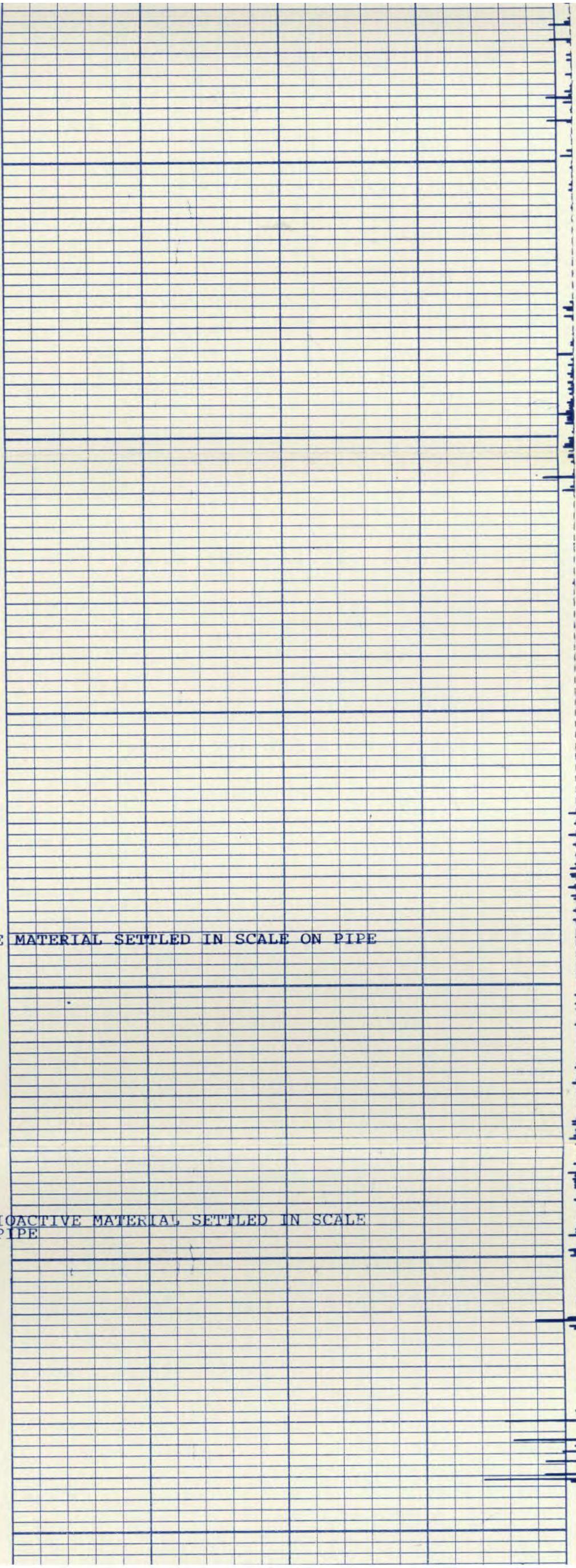
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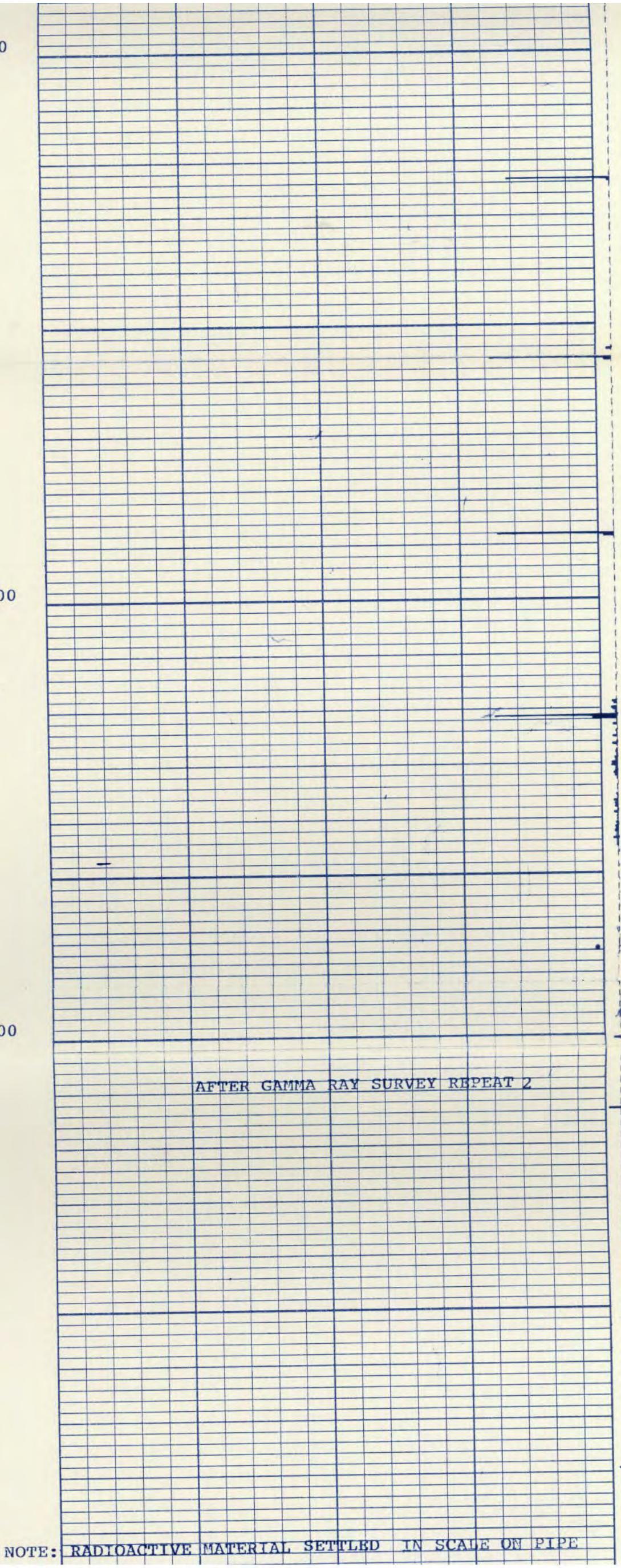
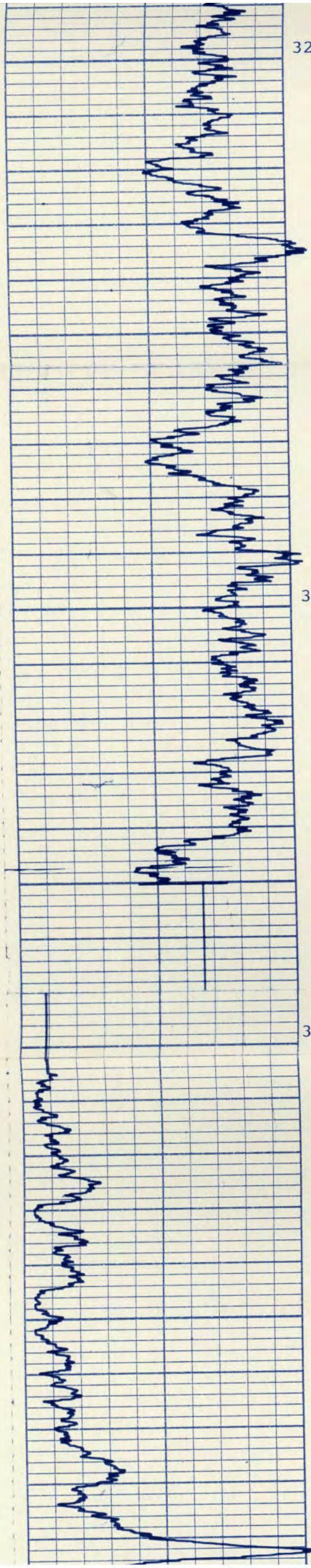
RADIOACTIVE MATERIAL SETTLED IN SCALE ON PIPE

3100

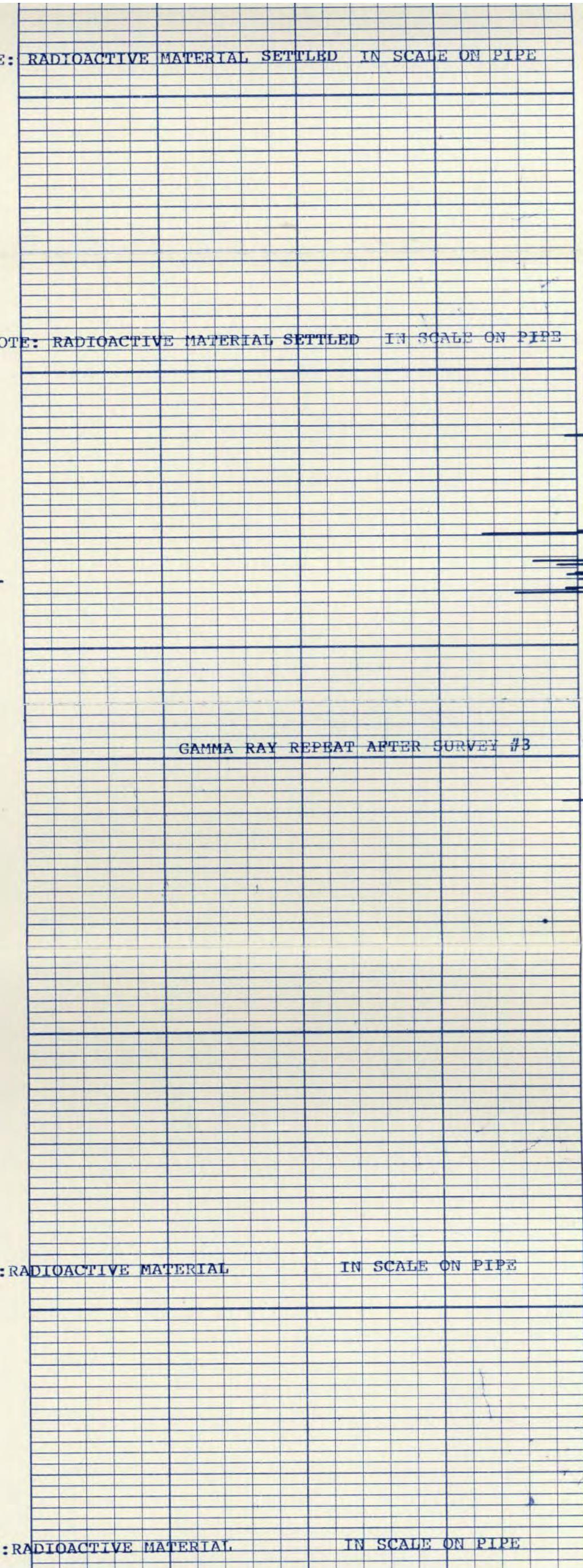
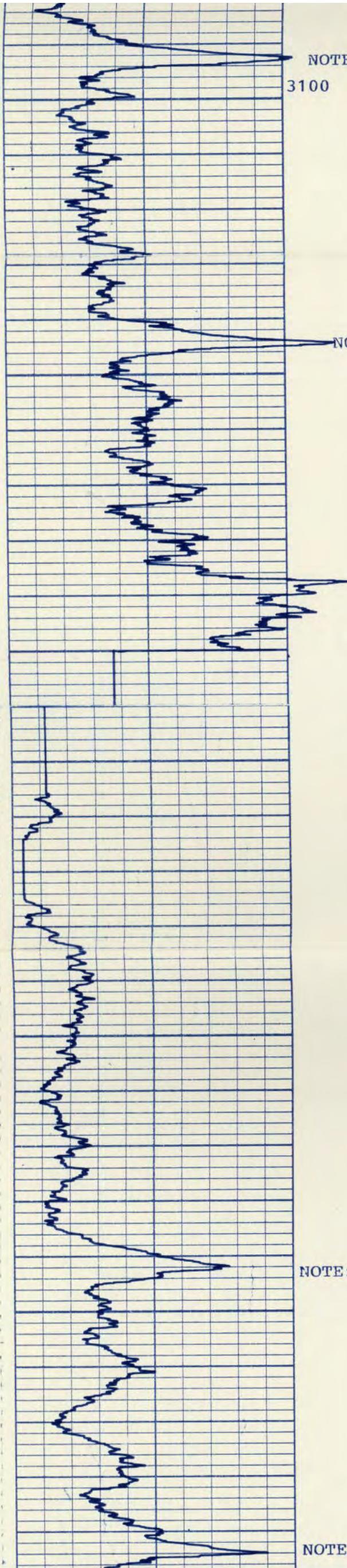
RADIOACTIVE MATERIAL SETTLED IN SCALE  
ON PIPE

3200



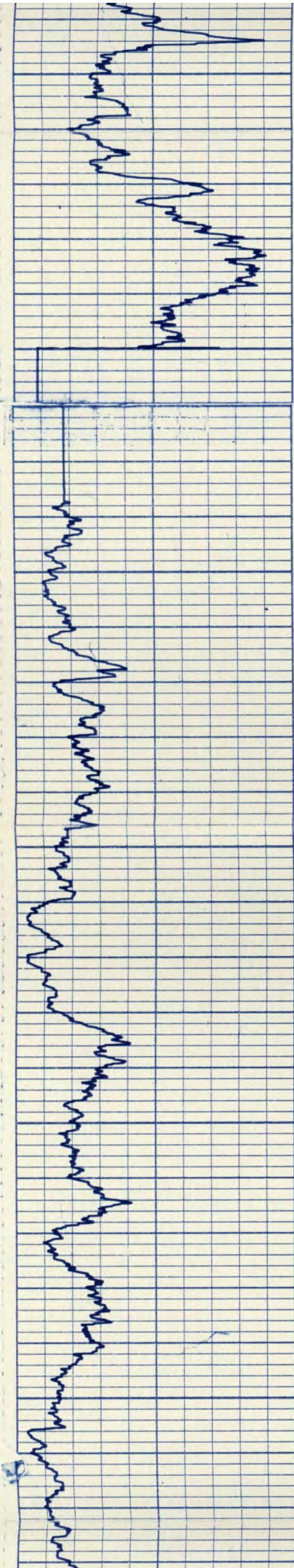


NOTE: RADIOACTIVE MATERIAL SETTLED IN SCALE ON PIPE

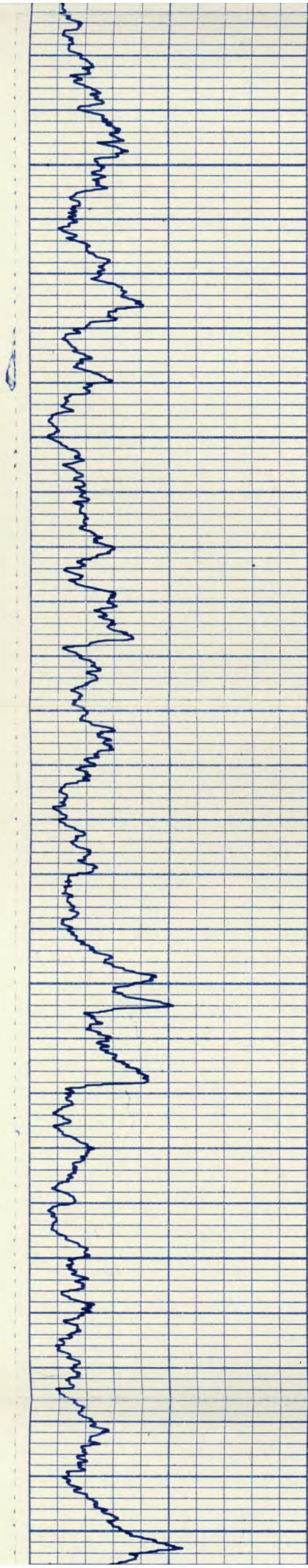


NOTE: RADIOACTIVE MATERIAL

IN SCALE ON PIPE



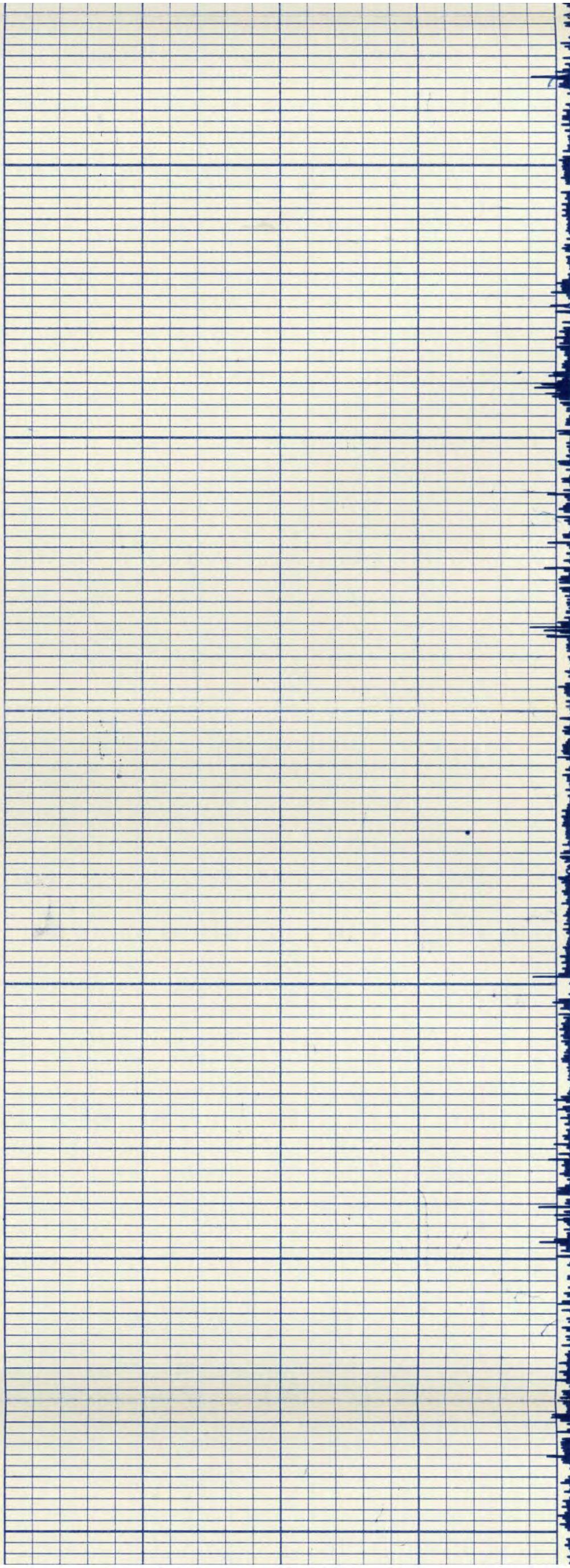
GAMMA RAY SURVEY AFTER BASE LOG

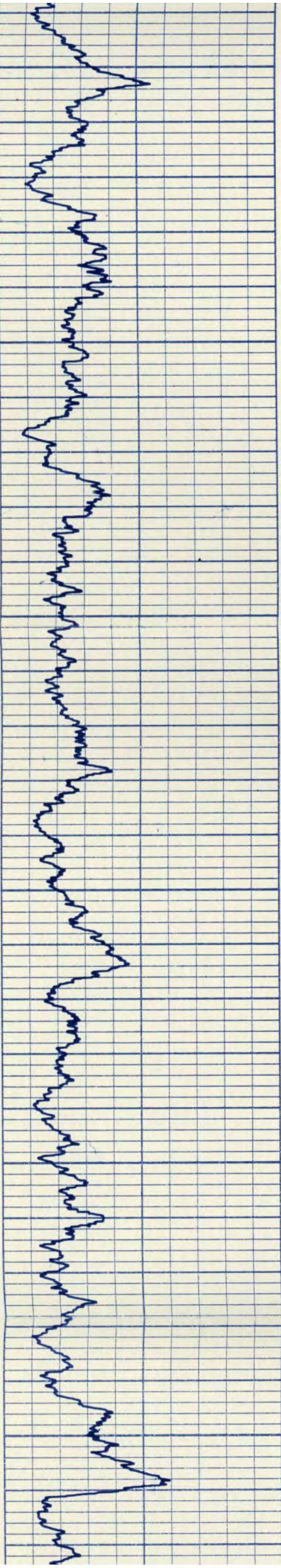


1700

1800

1900

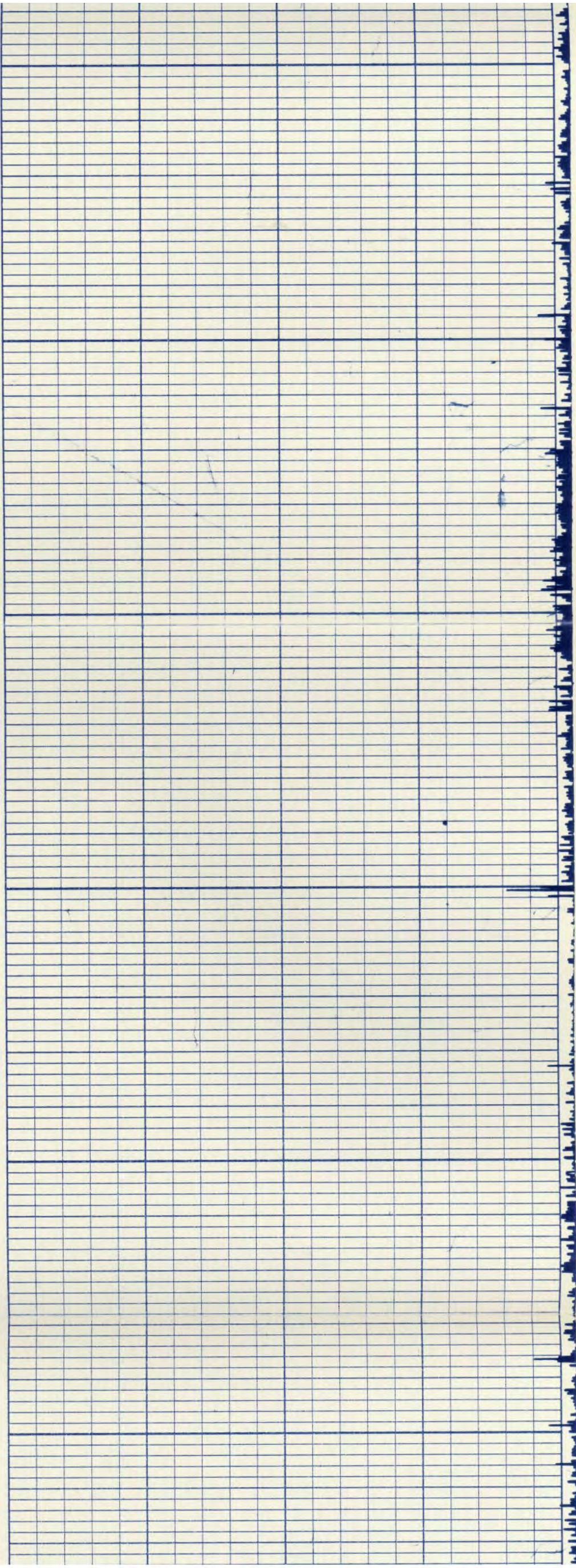


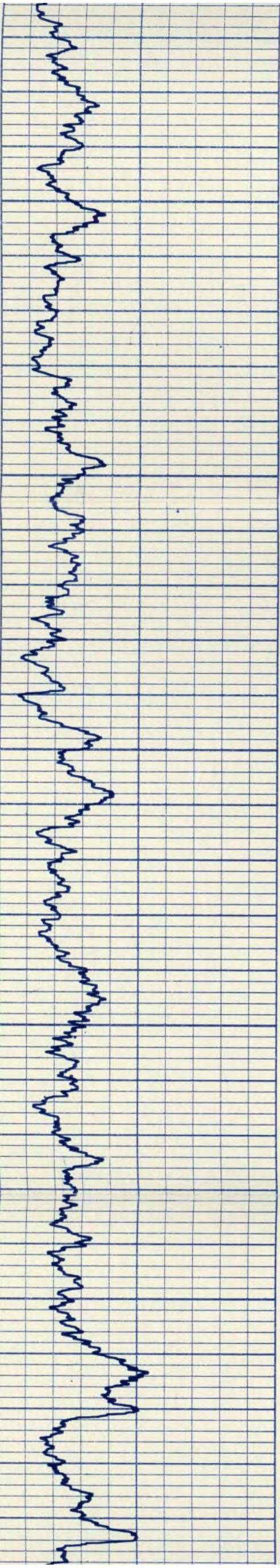


2000

2100

2200

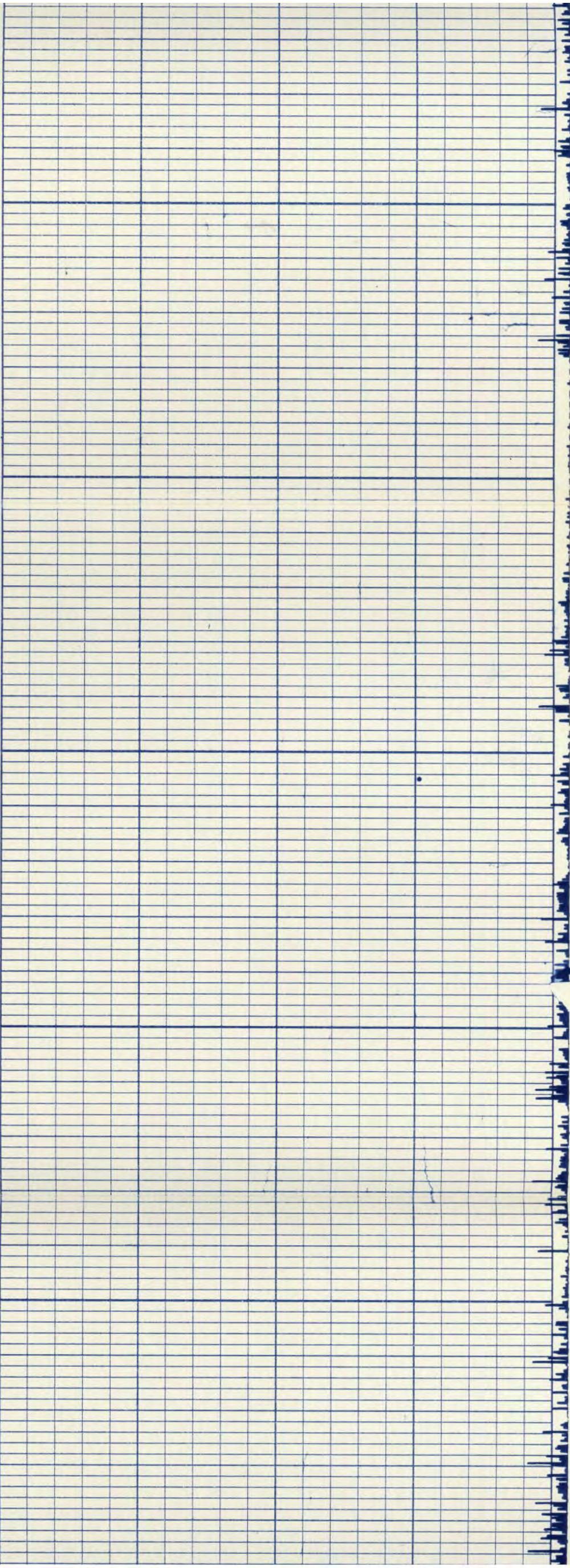




2300

2400

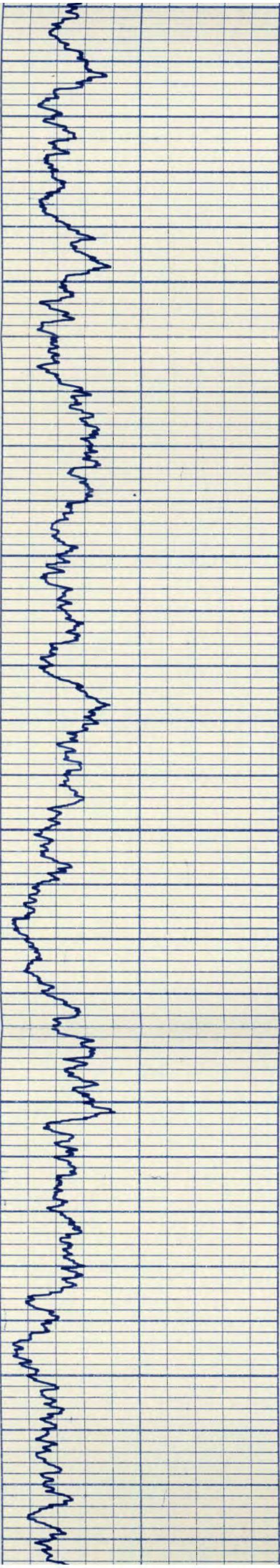
2500



2500

2600

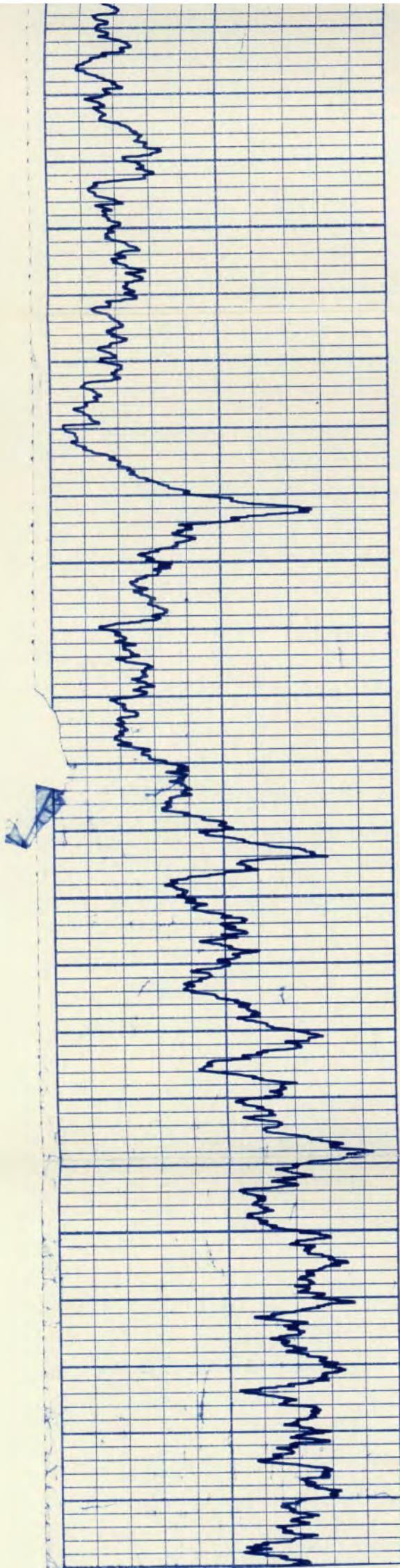
2700



2800

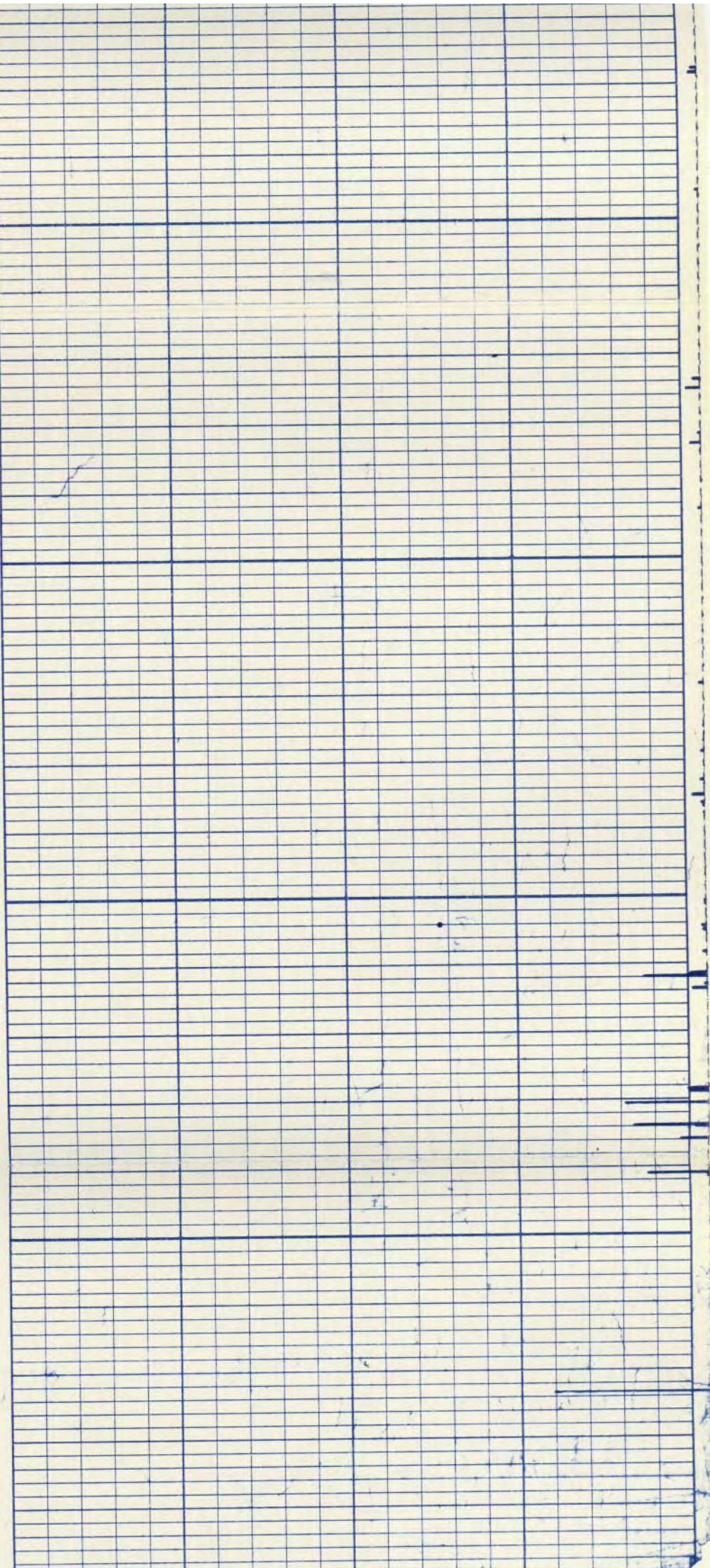
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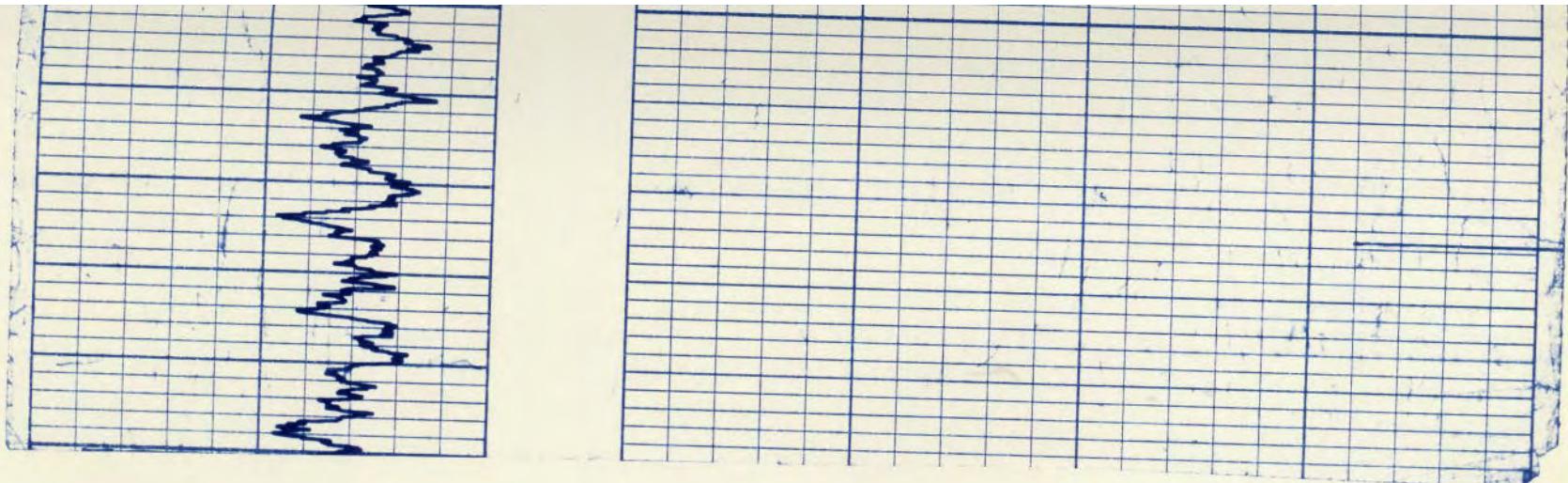
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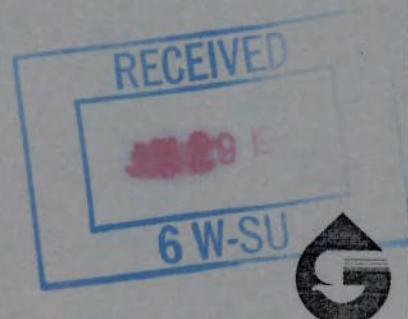
3100

3200





APPENDIX A.3  
WDW-14  
GULF COAST WELL ANALYSIS LOG INTERPRETATION LETTER



APPENDIX A.4  
WDW-14  
STATIC AND FALL-OFF BOTTOM HOLE PRESSURE DATA



GULF  
COAST  
WELL  
ANALYSIS

COASTAL WIRELINE SERVICES, INC.

HOECHST CELANESE CORPORATION  
CELANESE PLANT  
MATAGORDA COUNTY, TEXAS  
EFFLUENT DISPOSAL WELL #2

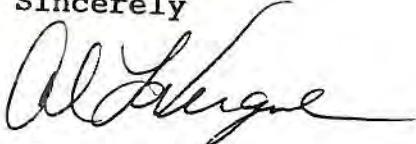
OCTOBER 29, 1990

To whom it may concern:

Radioactive Tracer Log was run to check for channeling.

Radioactive Tracer Log indicates that all fluid is going into disposal zone at this time. No indication of leaking or channeling behind pipe. This concludes Gulf Coast Well Analysis log interpretation for Effluent Disposal Well #2.

Sincerely



Al LaVergne

RECEIVED

6W-SU

P.O. Box 2308 Pearland, Texas 77588 (713) 485-6548



## **Data Retrieval Corporation**

### **WELL TEST DATA**

---

### **WELL HEAD PRESSURE DATA**

---

COMPANY NAME : HOECHST CELANESE  
WELL NAME: : WDW 14-2  
SPIDR S/N : 1007  
ENGINEER : BOB HALL/RAY HORTON  
LOCATION : BAY CITY, TEXAS  
DATE : OCT. 29-31, 1990  
SAMPLE WINDOW : 2 PSI  
SAMPLE RATE : 15 SECONDS

---

### **WELL DATA**

---

TUBING LENGTH : 3,400 FT.  
TRUE VERTICAL DEPTH : 3,400 FT.

---

### **FLUIDS DATA**

---

INJ. FUID GRAVITY: 1.0

---

### **TEST SUMMARY**

---

MIN WHP :	94 PSIA	MAX WHP:	412 PSIA
MIN BHP :	1,566 PSIA	MIN BHP:	1,884 PSIA

---

BHP'S WERE CALCULATED USING A 0.433 PSI/FT GRADIENT

DATA RETRIEVAL WELL TEST

Company : GOLDEN STRATA  
Well Name : WDW14-2  
Lease : BAY CITY PLANT  
Location : BAY CITY, TEXAS  
SPIDR s.n.: 1007

Active Channels : 1

Start Time : Monday, 10/29/90 21:00:20  
End Time : Wednesday, 10/31/90 11:37:35  
Readings : 193  
Sample Window : 2 psi  
Sample Rate : 00:00:15 240 samples/hr.

CHANNEL 1

Label: WHP  
Min. : 91.8 Psia  
Max. : 412.9 Psia

Report Columns :

Column # Label

1	WHP	Min.:	94.00	Tuesday, 10/30/90 01:03:20
		Max.:	412.00	Wednesday, 10/31/90 10:28:35
2	Elapsed T	Min.:	21.01	Monday, 10/29/90 21:00:20
		Max.:	59.63	Wednesday, 10/31/90 11:37:35
3	BHP	Min.:	1566.20	Tuesday, 10/30/90 01:03:20
		Max.:	1884.20	Wednesday, 10/31/90 10:28:35
4	Delta T	Min.:	0.00	Monday, 10/29/90 21:00:20
		Max.:	38.62	Wednesday, 10/31/90 11:37:35

Location : BAY CITY, TEXAS

Lease : BAY CITY PLANT

Record	Date	Time	WHP	Elapsed T	BHP	Delta T
			Psia	Hours	Psia	Hours
0001	10/29/90	21:00:20	177.00	21.01	1649.20	0.00
0049	Monday	23:55:50	176.00	23.93	1648.20	2.92
0050		23:56:05	165.00	23.93	1637.20	2.93
0051		23:56:20	163.00	23.94	1635.20	2.93
0052		23:56:35	160.00	23.94	1632.20	2.94
0053		23:56:50	157.00	23.95	1629.20	2.94
0055		23:57:20	153.00	23.96	1625.20	2.95
0056		23:57:35	151.00	23.96	1623.20	2.95
0058		23:58:05	147.00	23.97	1619.20	2.96
0059		23:58:20	144.00	23.97	1616.20	2.97
0061		23:59:20	140.00	23.99	1612.20	2.98
0062		23:59:50	137.00	24.00	1609.20	2.99
0063	10/30/90	00:00:20	134.00	24.01	1606.20	3.00
0065	Tuesday	00:01:20	130.00	24.02	1602.20	3.02
0066		00:02:05	128.00	24.03	1600.20	3.03
0068		00:03:20	124.00	24.06	1596.20	3.05
0069		00:03:50	122.00	24.06	1594.20	3.06
0071		00:05:50	118.00	24.10	1590.20	3.09
0072		00:06:35	116.00	24.11	1588.20	3.10
0074		00:08:50	112.00	24.15	1584.20	3.14
0075		00:09:50	110.00	24.16	1582.20	3.16
0077		00:14:05	106.00	24.23	1578.20	3.23
0078		00:16:20	104.00	24.27	1576.20	3.27
0081		00:27:05	100.00	24.45	1572.20	3.45
0082		00:29:35	98.00	24.49	1570.20	3.49
0090		00:59:35	95.00	24.99	1567.20	3.99
0091		01:03:20	94.00	25.06	1566.20	4.05
0334		14:54:35	93.00	38.91	1565.20	17.90
0335		14:55:50	97.00	38.93	1569.20	17.92
0336		14:56:05	106.00	38.93	1578.20	17.93
0337		14:56:20	101.00	38.94	1573.20	17.93
0339		14:57:20	97.00	38.96	1569.20	17.95
0340		14:59:20	95.00	38.99	1567.20	17.98
0356		15:59:20	93.00	39.99	1565.20	18.98
0357		16:01:05	96.00	40.02	1568.20	19.01
0359		16:07:50	97.00	40.13	1569.20	19.12
0360		16:09:35	95.00	40.16	1567.20	19.15
0381		17:28:20	93.00	41.47	1565.20	20.47
0382		17:29:20	97.00	41.49	1569.20	20.48
0383		17:29:35	115.00	41.49	1587.20	20.49
0384		17:29:50	129.00	41.50	1601.20	20.49
0385		17:30:05	147.00	41.50	1619.20	20.50
0386		17:30:20	162.00	41.51	1634.20	20.50
0387		17:30:35	171.00	41.51	1643.20	20.50
0388		17:30:50	184.00	41.51	1656.20	20.51
0389		17:31:05	195.00	41.52	1667.20	20.51
0390		17:31:20	201.00	41.52	1673.20	20.52
0391		17:31:35	205.00	41.53	1677.20	20.52
0392		17:31:50	208.00	41.53	1680.20	20.52
0393		17:32:05	214.00	41.53	1686.20	20.53

Location : BAY CITY, TEXAS

Lease : BAY CITY PLANT

Record	Date	Time	WHP	Elapsed T	BHP	Delta T
			Psia	Hours	Psia	Hours
0394	10/30/90	17:32:20	217.00	41.54	1689.20	20.53
0395	Tuesday	17:32:35	219.00	41.54	1691.20	20.54
0396		17:32:50	224.00	41.55	1696.20	20.54
0397		17:33:05	233.00	41.55	1705.20	20.55
0398		17:34:05	235.00	41.57	1707.20	20.56
0399		17:34:20	243.00	41.57	1715.20	20.57
0401		17:35:05	247.00	41.58	1719.20	20.58
0402		17:35:50	249.00	41.60	1721.20	20.59
0403		17:37:05	253.00	41.62	1725.20	20.61
0404		17:37:20	256.00	41.62	1728.20	20.62
0405		17:37:50	258.00	41.63	1730.20	20.62
0406		17:38:05	263.00	41.63	1735.20	20.63
0408		17:39:20	267.00	41.66	1739.20	20.65
0409		17:39:50	270.00	41.66	1742.20	20.66
0410		17:40:05	276.00	41.67	1748.20	20.66
0411		17:40:35	282.00	41.68	1754.20	20.67
0412		17:41:05	288.00	41.68	1760.20	20.68
0414		17:41:50	292.00	41.70	1764.20	20.69
0415		17:42:05	294.00	41.70	1766.20	20.70
0416		17:43:05	298.00	41.72	1770.20	20.71
0417		17:43:50	300.00	41.73	1772.20	20.73
0418		17:44:50	304.00	41.75	1776.20	20.74
0423		17:50:35	304.00	41.84	1776.20	20.84
0432		18:24:20	305.00	42.41	1777.20	21.40
0447		19:16:35	307.00	43.28	1779.20	22.27
0448		19:18:05	309.00	43.30	1781.20	22.30
0449		19:18:50	306.00	43.31	1778.20	22.31
0473		20:09:35	308.00	44.16	1780.20	23.15
0474		20:09:50	311.00	44.16	1783.20	23.16
0508		21:43:05	310.00	45.72	1782.20	24.71
0509		21:46:20	312.00	45.77	1784.20	24.77
0523		22:23:35	311.00	46.39	1783.20	25.39
0524		22:23:50	301.00	46.40	1773.20	25.39
0525		22:24:35	296.00	46.41	1768.20	25.40
0526		22:24:50	265.00	46.41	1737.20	25.41
0527		22:25:05	262.00	46.42	1734.20	25.41
0529		22:26:35	258.00	46.44	1730.20	25.44
0530		22:27:50	256.00	46.46	1728.20	25.46
0533		22:36:50	253.00	46.61	1725.20	25.61
0534		22:37:05	244.00	46.62	1716.20	25.61
0535		22:37:20	240.00	46.62	1712.20	25.62
0537		22:39:05	236.00	46.65	1708.20	25.65
0538		22:41:20	227.00	46.69	1699.20	25.68
0540		22:43:35	223.00	46.73	1695.20	25.72
0541		22:46:35	221.00	46.78	1693.20	25.77
0542		22:46:50	181.00	46.78	1653.20	25.77
0543		22:47:05	173.00	46.78	1645.20	25.78
0544		22:47:20	209.00	46.79	1681.20	25.78
0545		22:47:35	174.00	46.79	1646.20	25.79
0546		22:47:50	166.00	46.80	1638.20	25.79

Location : BAY CITY, TEXAS

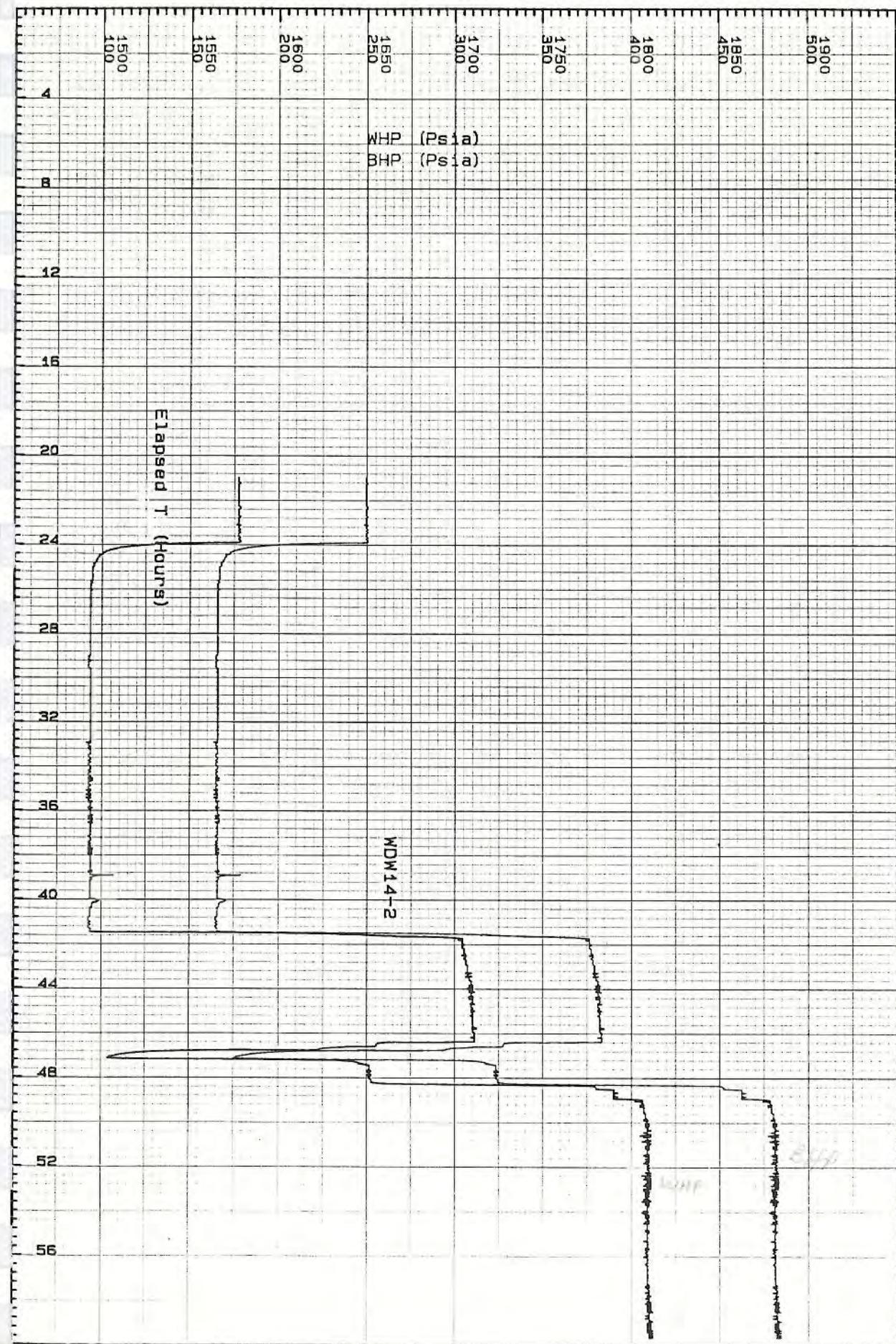
Lease : BAY CITY PLANT

Record	Date	Time	WHP	Elapsed T	BHP	Delta T
			Psia	Hours	Psia	Hours
0547	10/30/90	22:48:05	164.00	46.80	1636.20	25.80
0548	Tuesday	22:48:20	160.00	46.81	1632.20	25.80
0549		22:48:35	156.00	46.81	1628.20	25.80
0550		22:48:50	153.00	46.81	1625.20	25.81
0551		22:49:05	150.00	46.82	1622.20	25.81
0552		22:49:20	146.00	46.82	1618.20	25.82
0553		22:50:05	142.00	46.83	1614.20	25.83
0555		22:50:35	138.00	46.84	1610.20	25.84
0556		22:50:50	136.00	46.85	1608.20	25.84
0557		22:51:20	133.00	46.86	1605.20	25.85
0558		22:51:50	131.00	46.86	1603.20	25.86
0559		22:52:20	128.00	46.87	1600.20	25.87
0561		22:53:35	124.00	46.89	1596.20	25.89
0562		22:53:50	122.00	46.90	1594.20	25.89
0564		22:55:20	118.00	46.92	1590.20	25.92
0565		22:56:20	116.00	46.94	1588.20	25.93
0567		22:58:20	112.00	46.97	1584.20	25.97
0568		23:00:05	110.00	47.00	1582.20	26.00
0570		23:04:05	106.00	47.07	1578.20	26.06
0571		23:05:20	104.00	47.09	1576.20	26.08
0573		23:09:50	105.00	47.16	1577.20	26.16
0574		23:10:20	110.00	47.17	1582.20	26.17
0575		23:10:35	114.00	47.18	1586.20	26.17
0576		23:10:50	118.00	47.18	1590.20	26.17
0577		23:11:05	120.00	47.18	1592.20	26.18
0578		23:11:20	126.00	47.19	1598.20	26.18
0579		23:11:35	137.00	47.19	1609.20	26.19
0580		23:11:50	159.00	47.20	1631.20	26.19
0581		23:12:05	167.00	47.20	1639.20	26.20
0582		23:12:20	171.00	47.21	1643.20	26.20
0583		23:12:35	174.00	47.21	1646.20	26.20
0584		23:12:50	201.00	47.21	1673.20	26.21
0585		23:13:05	209.00	47.22	1681.20	26.21
0586		23:13:20	214.00	47.22	1686.20	26.22
0587		23:13:35	226.00	47.23	1698.20	26.22
0588		23:13:50	230.00	47.23	1702.20	26.23
0590		23:14:20	234.00	47.24	1706.20	26.23
0591		23:15:05	236.00	47.25	1708.20	26.25
0592		23:15:50	238.00	47.26	1710.20	26.26
0593		23:16:35	241.00	47.28	1713.20	26.27
0595		23:19:50	245.00	47.33	1717.20	26.33
0596		23:22:50	247.00	47.38	1719.20	26.38
0598		23:24:05	247.00	47.40	1719.20	26.40
0599		23:25:35	249.00	47.43	1721.20	26.42
0618	10/31/90	00:13:05	252.00	48.22	1724.20	27.21
0619	Wednesday	00:16:20	258.00	48.27	1730.20	27.27
0620		00:17:50	284.00	48.30	1756.20	27.29
0621		00:18:05	292.00	48.30	1764.20	27.30
0622		00:18:35	294.00	48.31	1766.20	27.30
0623		00:18:50	305.00	48.31	1777.20	27.31

Location : BAY CITY, TEXAS

Lease : BAY CITY PLANT

Record	Date	Time	WHP	Elapsed T	BHP	Delta T
			Psia	Hours	Psia	Hours
0624	10/31/90	00:19:05	313.00	48.32	1785.20	27.31
0625	Wednesday	00:19:20	322.00	48.32	1794.20	27.32
0626		00:19:35	333.00	48.33	1805.20	27.32
0627		00:19:50	337.00	48.33	1809.20	27.33
0628		00:20:05	346.00	48.33	1818.20	27.33
0629		00:20:20	351.00	48.34	1823.20	27.33
0630		00:20:35	359.00	48.34	1831.20	27.34
0631		00:20:50	374.00	48.35	1846.20	27.34
0632		00:21:05	377.00	48.35	1849.20	27.35
0635		00:30:05	380.00	48.50	1852.20	27.50
0636		00:31:20	386.00	48.52	1858.20	27.52
0637		00:31:35	390.00	48.53	1862.20	27.52
0646		00:56:05	390.00	48.93	1862.20	27.93
0647		00:56:50	396.00	48.95	1868.20	27.94
0648		00:57:20	399.00	48.96	1871.20	27.95
0649		00:58:05	404.00	48.97	1876.20	27.96
0652		01:01:50	406.00	49.03	1878.20	28.02
0653		01:02:35	402.00	49.04	1874.20	28.04
0655		01:03:35	406.00	49.06	1878.20	28.05
0665		01:32:50	407.00	49.55	1879.20	28.54
0684		02:18:20	409.00	50.31	1881.20	29.30
0685		02:21:05	411.00	50.35	1883.20	29.35
0692		02:32:35	409.00	50.54	1881.20	29.54
0693		02:35:20	405.00	50.59	1877.20	29.58
0694		02:35:35	409.00	50.59	1881.20	29.59
0696		02:38:05	409.00	50.63	1881.20	29.63
0697		02:39:35	407.00	50.66	1879.20	29.65
0703		02:49:35	409.00	50.83	1881.20	29.82
0704		02:51:20	406.00	50.86	1878.20	29.85
0707		02:56:05	409.00	50.93	1881.20	29.93
0708		02:57:05	411.00	50.95	1883.20	29.95
0747		04:23:05	409.00	52.38	1881.20	31.38
0748		04:23:35	406.00	52.39	1878.20	31.39
0749		04:23:50	410.00	52.40	1882.20	31.39
0750		04:27:20	408.00	52.46	1880.20	31.45
0751		04:28:35	411.00	52.48	1883.20	31.47
0803		05:32:05	409.00	53.53	1881.20	32.53
0804		05:32:50	406.00	53.55	1878.20	32.54
0900		09:45:05	409.00	57.75	1881.20	36.75
0901		09:46:20	411.00	57.77	1883.20	36.77
0933		10:28:20	409.00	58.47	1881.20	37.47
0934		10:28:35	412.00	58.48	1884.20	37.47
0983		11:37:35	410.00	59.63	1882.20	38.62

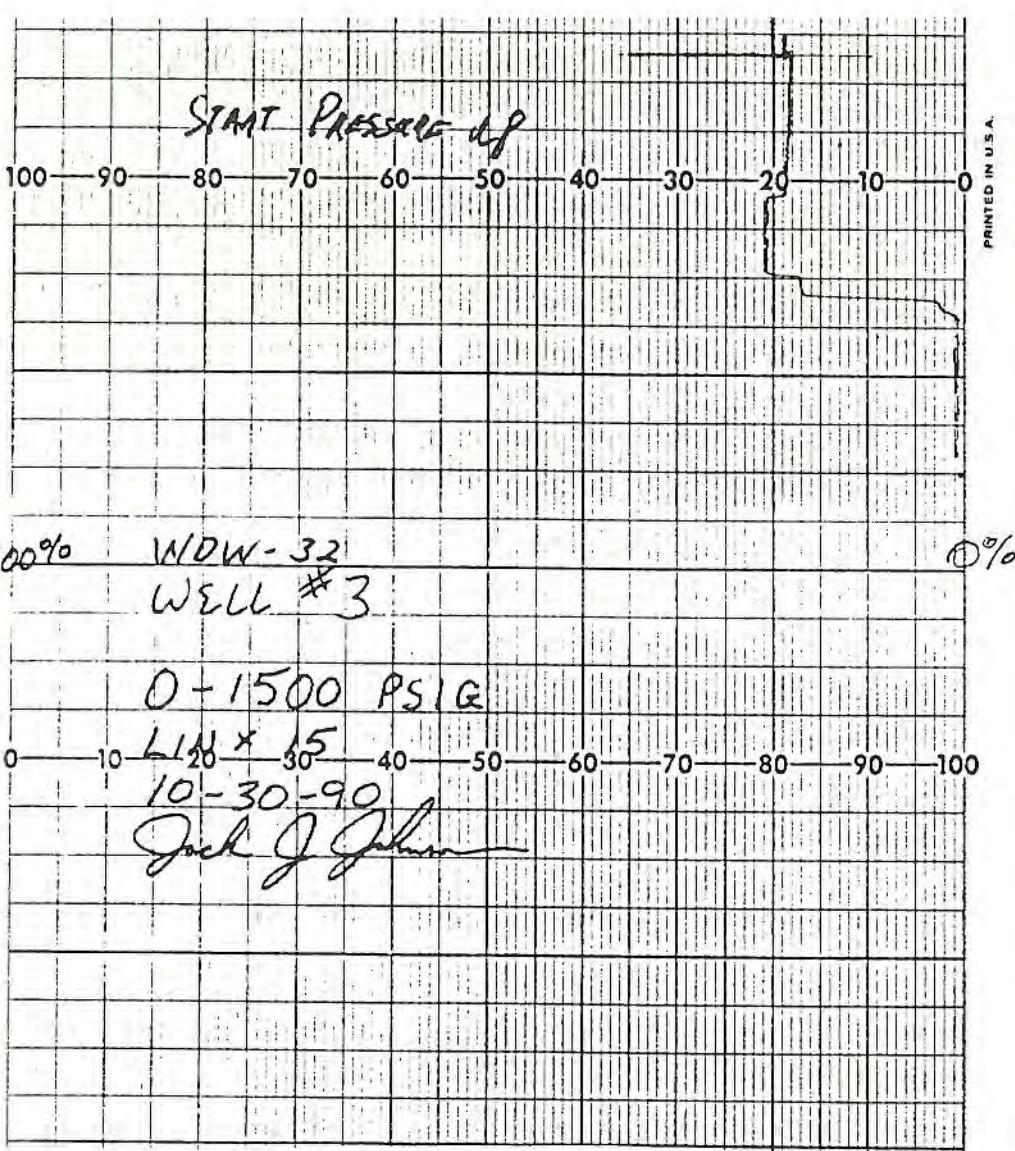


**APPENDIX B**  
**WASTE DISPOSAL WELL WDW-32**

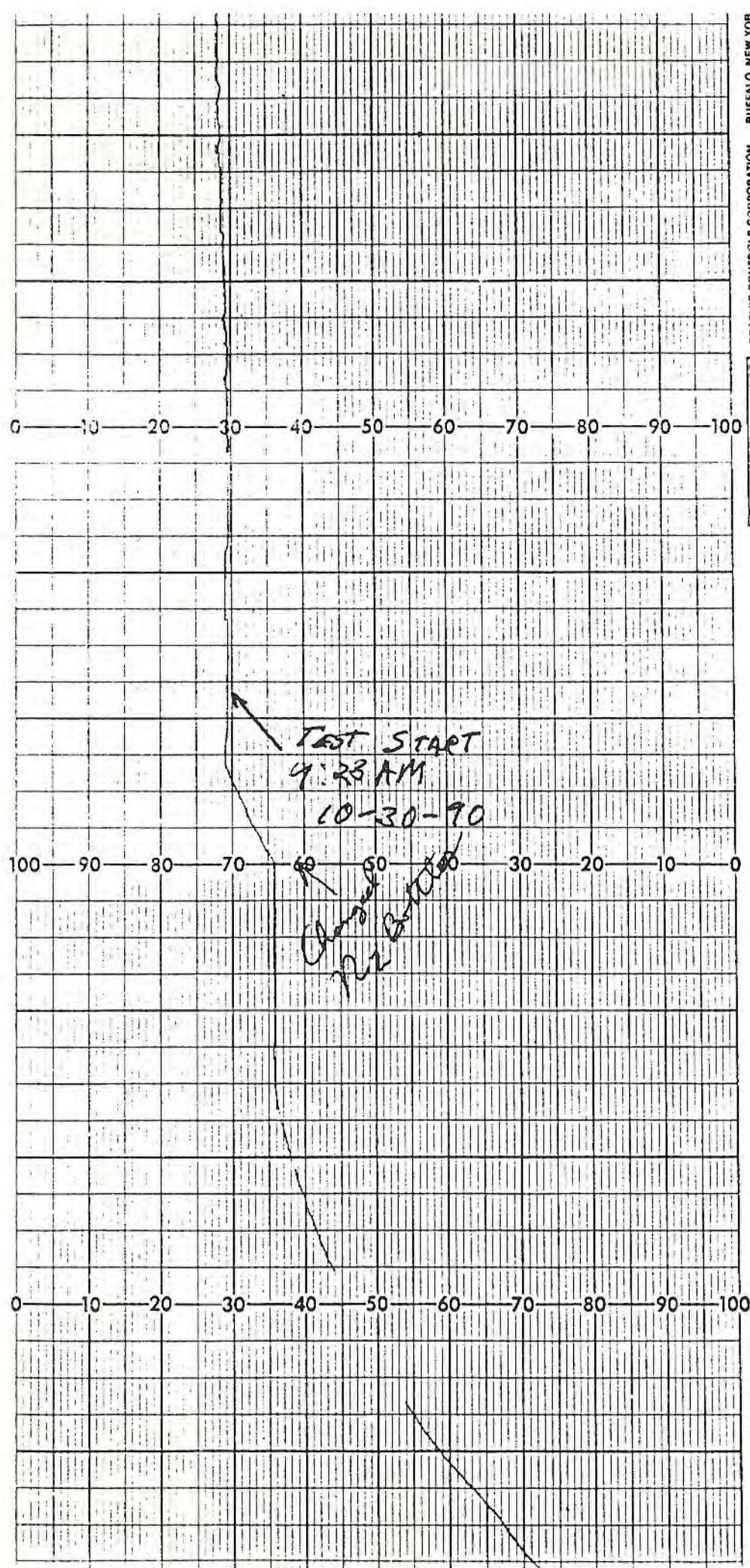


**APPENDIX B.1**  
**WDW-32**  
**ANNULUS PRESSURE DATA**





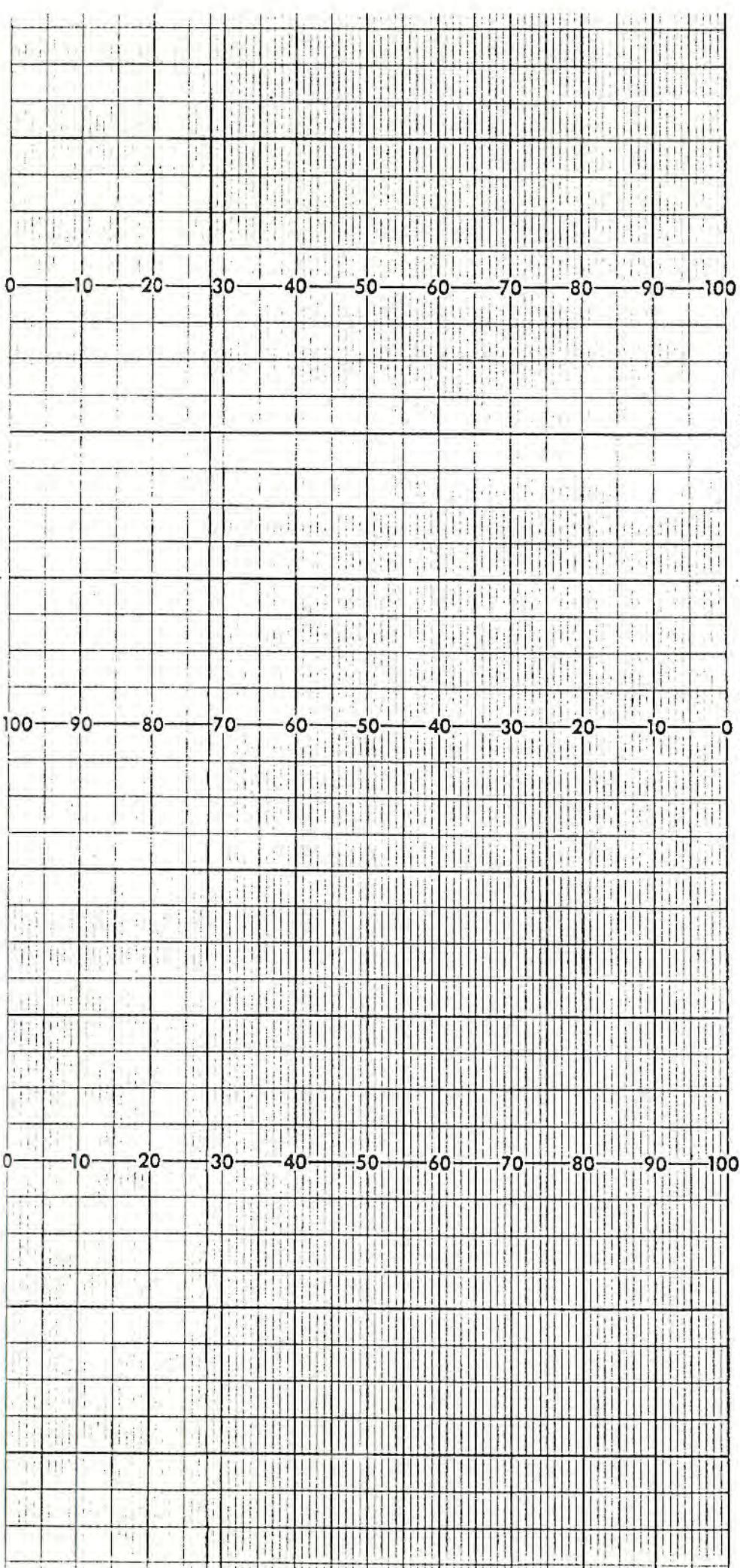
WDW-32



RECORDING CHARTS GRAPHIC CONTROLS CORPORATION BUFFALO, NEW YORK

No. 54-100

KODAK-32



No. 54-100

PRINTED IN U.S.A.

KDW-32

Mesal P. Norton

Hockey Celsius 40 0 - 50 - 80 70 80 90 100

Bob Ball  
Hockey Sticks 10 50 90

100 90 80 70 60 50 40 30 20 10 0

0 10 20 30 40 50 60 70 80 90 100

RECORDING CHARTS GRAPHIC CONTROLS CORPORATION BUFFALO, NEW YORK

10.03 AM

LAST STOP

100 90 80 70 60 50 40 30 20 10 0

**APPENDIX B.2**  
**WDW-32**  
**RADIOACTIVE TRACER SURVEY**



## Gulf Coast Well Analysis

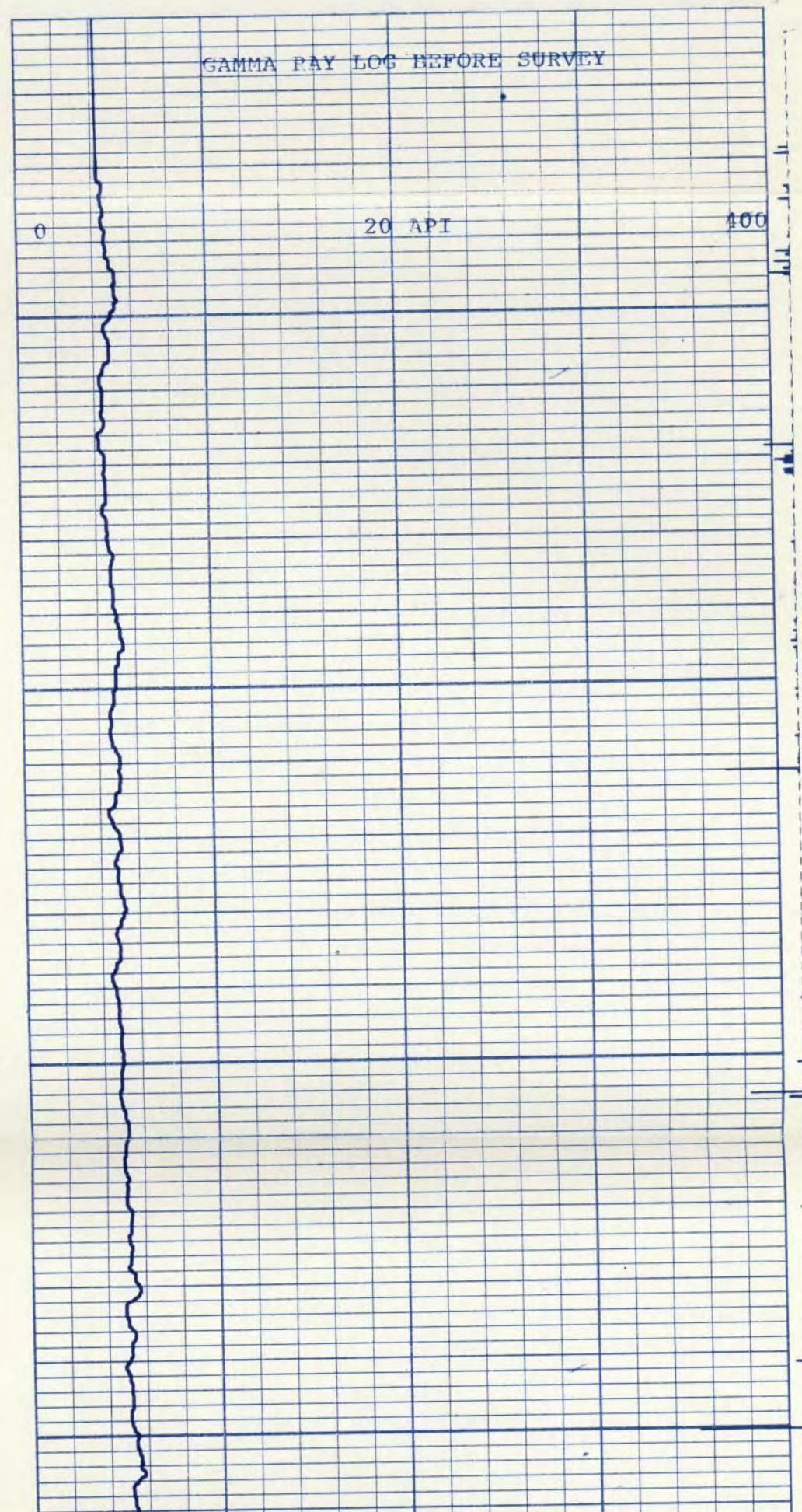
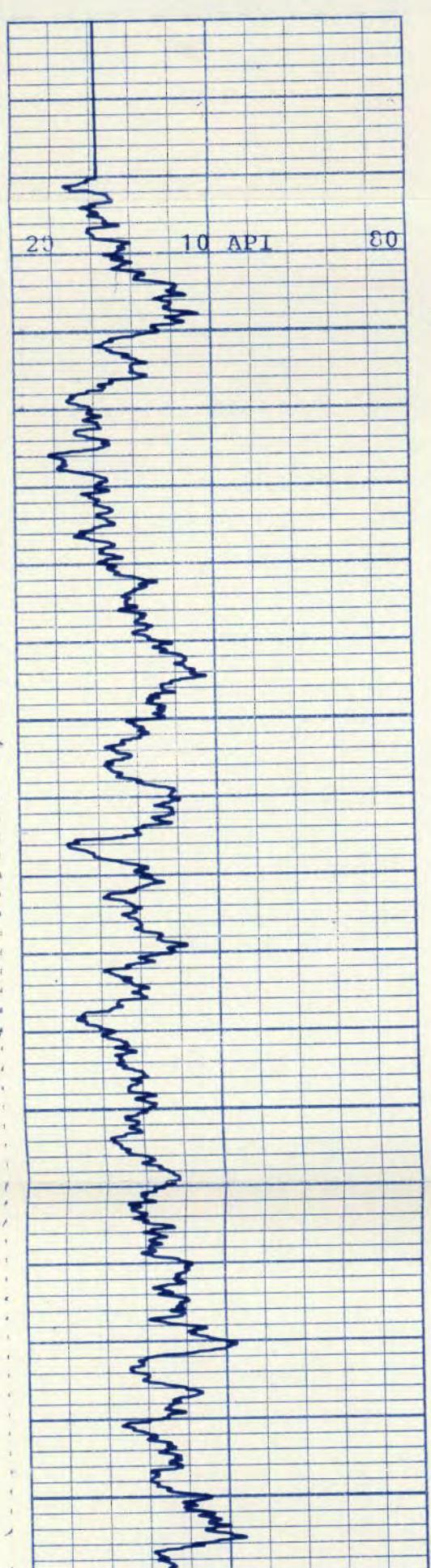
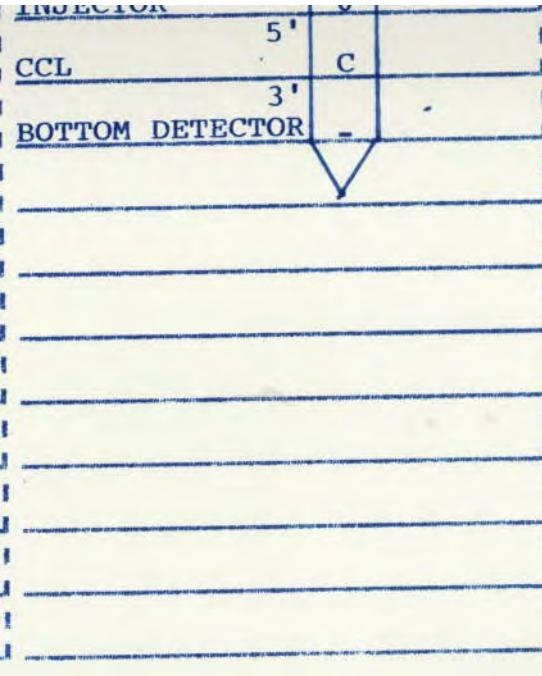
RADIOACTIVE TRACER SURVEY

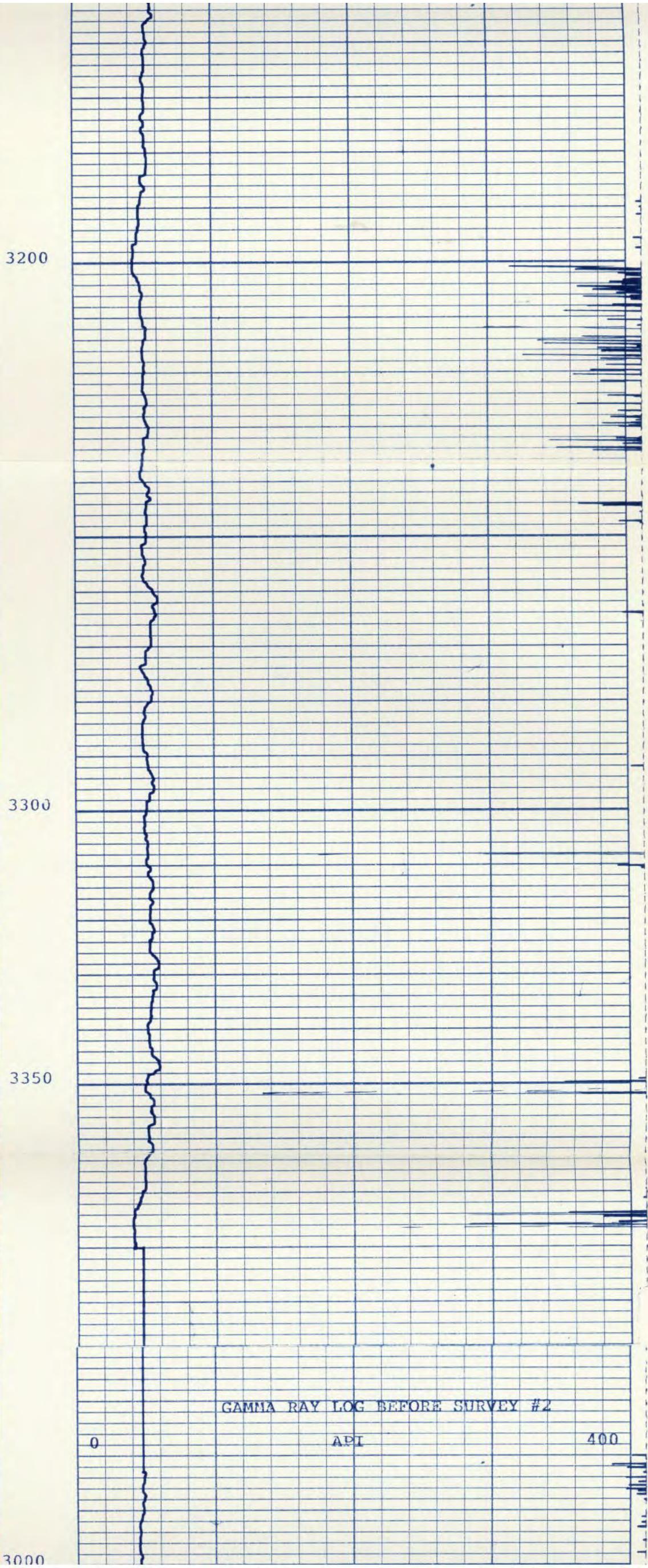
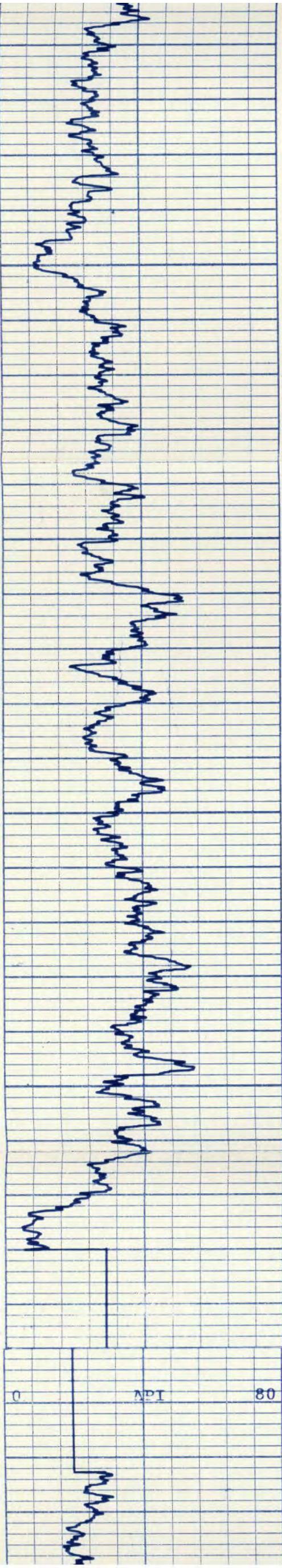
FILING NO.	
PEARLAND	COMPANY <u>HOECHST CELANESE CORPORATION</u>
WELL	EFFLUENT DISPOSAL WELL #3
FIELD	CELANESE PLANT
COUNTY	MATAGORDA
LOCATION:	STATE <u>TEXAS</u>
SEC.	NA
TWP.	NA
RGE.	NA
PERMANENT DATUM:	GROUND LEVEL
LOG MEASURED FROM	<u>17</u> FT. ABOVE PERM. DATUM
DRILLING MEASURED FROM	KELY BUSHING
OTHER SERVICES:	ELEV.: NA D.F. NA G.L. NA

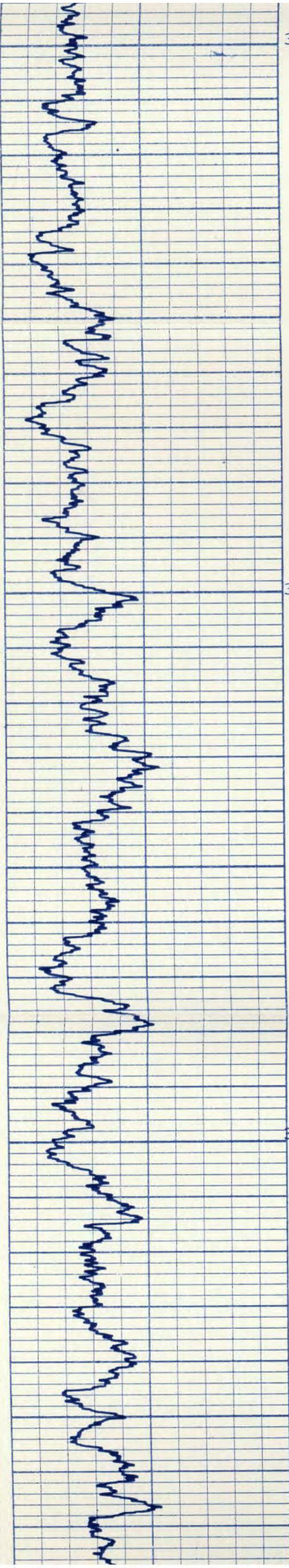
**NOTICE:** All interpretations are opinions based on inferences from electrical or other measurements and we cannot, and do not, guarantee the accuracy or correctness of any interpretations, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages or expenses incurred or sustained by anyone resulting from any interpretation made by one of our officers, agents or employees. These interpretations are also subject to our General Terms and Conditions as set out in our current Price Schedule.

**BIOLOGICAL TRACER LOG SUMMARY SHEET**

Run	Time	Depth	Rate	TC	Description
1	12:30	13:00	2980	3380	STATIC 3 GAMMA RAY LOG BEFORE SURVEY <sup>1</sup>
2	13:10	13:30	2980	3372	STATIC 3 GAMMA RAY LOG BEFORE SURVEY <sup>2</sup>
3	13:40	13:45		3190	STATIC 3 STATISTICAL CHECK AT 3190'
4	13:50	13:55		3190	STATIC 3 STATISTICAL CHECK AT 3190'
5		14:50		3050	40 GPM 3 INJECTED 5 SEC., 10 MCI.
6		14:53		3160	40 GPM 3 PASS #1 PEAK AT 3160'
7		14:57		3240	40 GPM 3 PASS #2 PEAK AT 3240'
8		15:02		3345	40 GPM 3 PASS #3 PEAK AT 3345'
9	16:00	16:30		3190	120GPM 3 STATIONARY CHECK AT 3190' 40 MIN.
10	17:00	17:40	2940	3380	120GPM 3 GAMMA RAY LOG AFTER SURVEY
					TOP DETECTOR +
					INJECTOR 3' 0
					5'



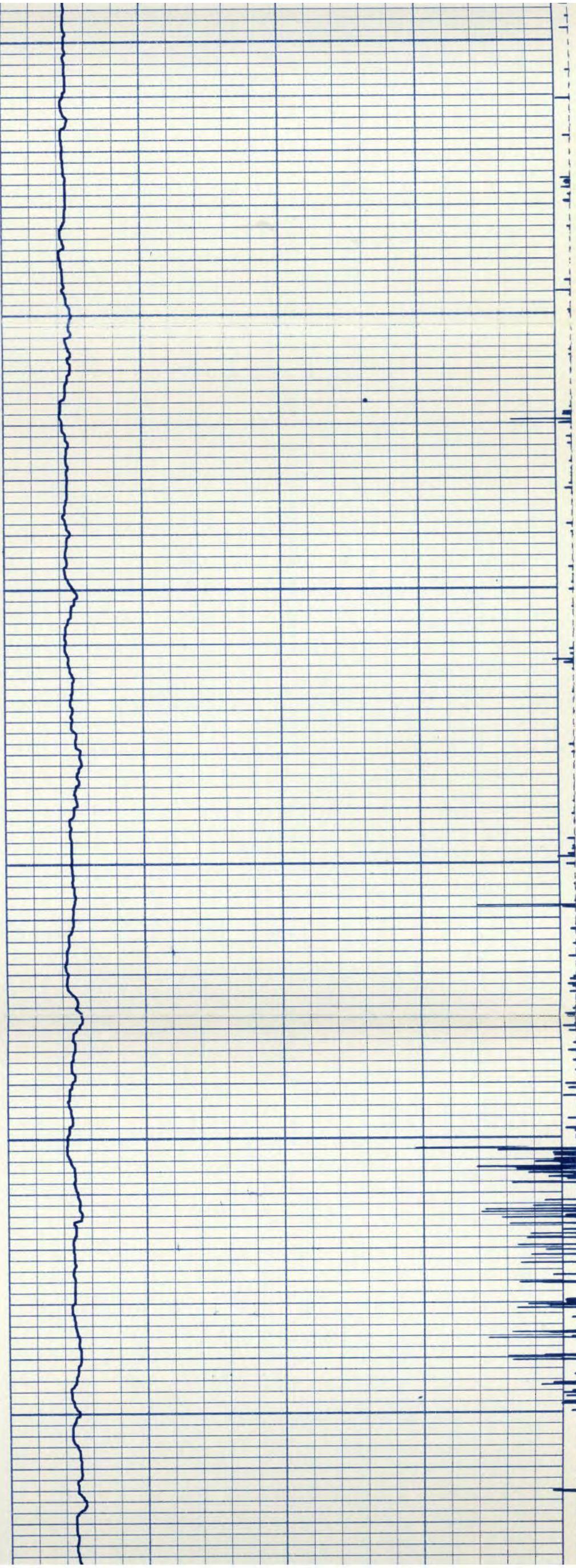


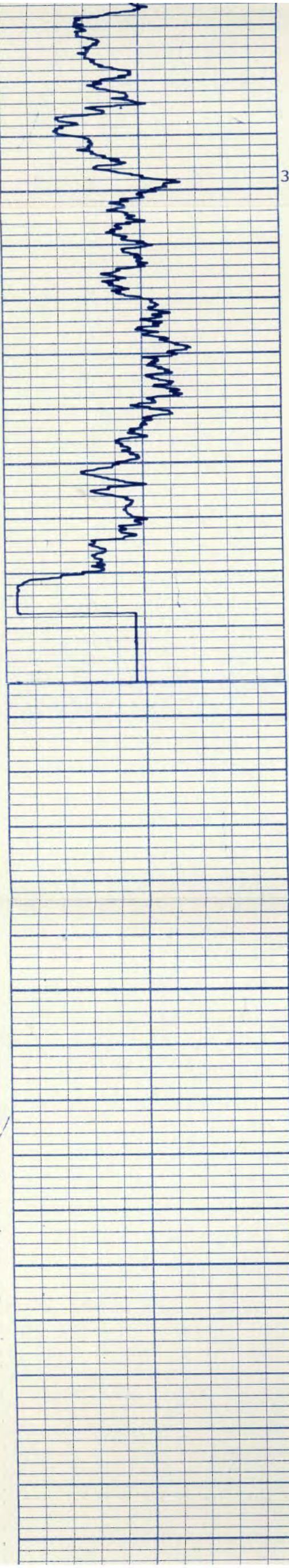


3000

3100

3200

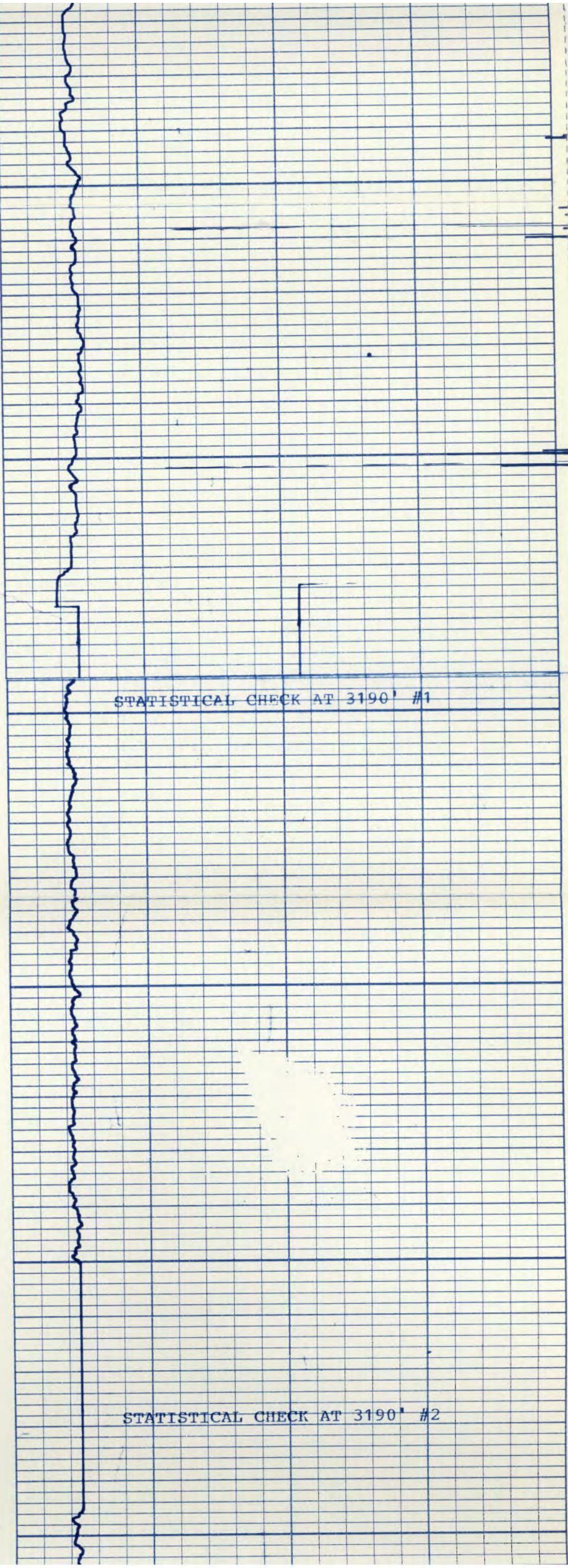


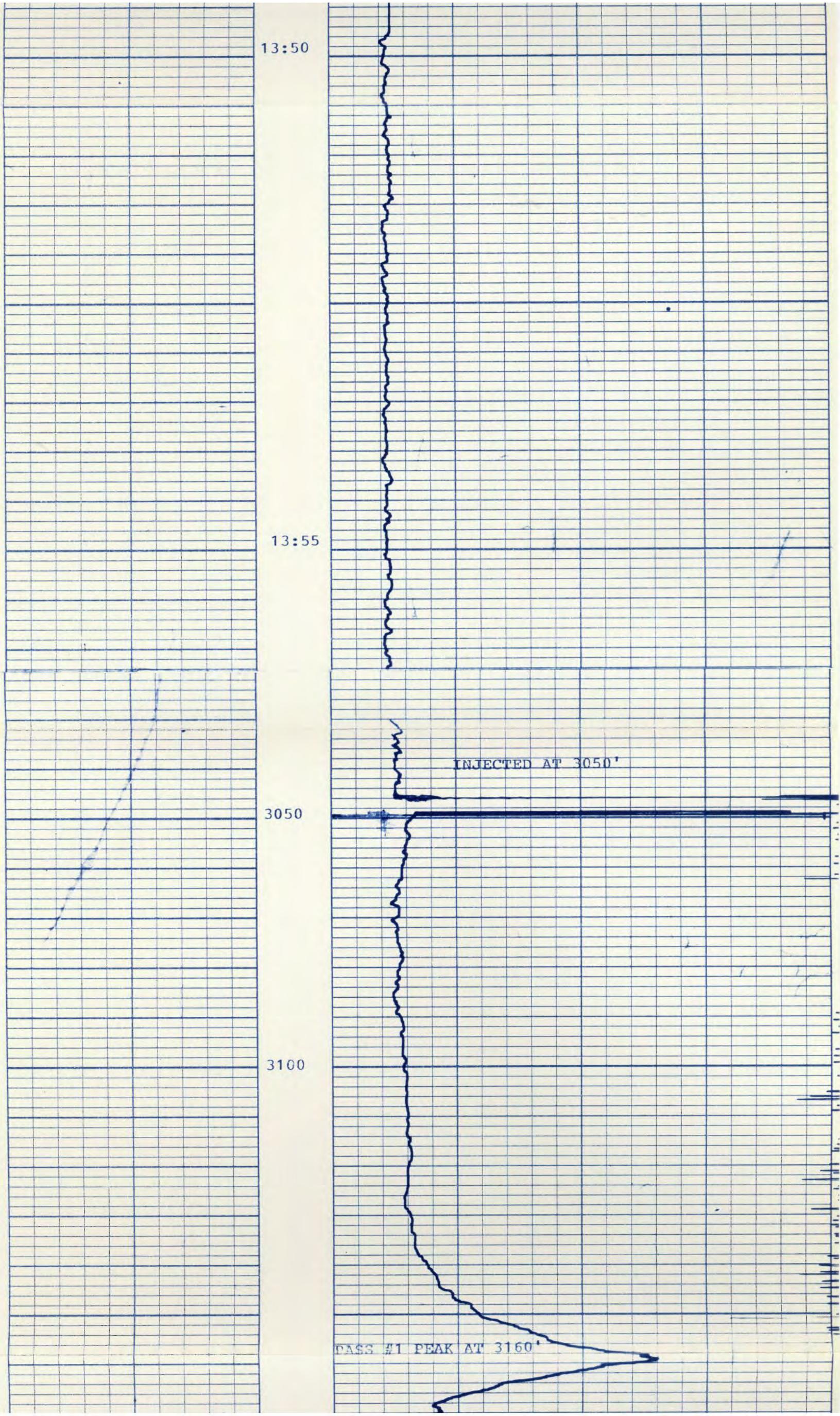


13:40

13:45

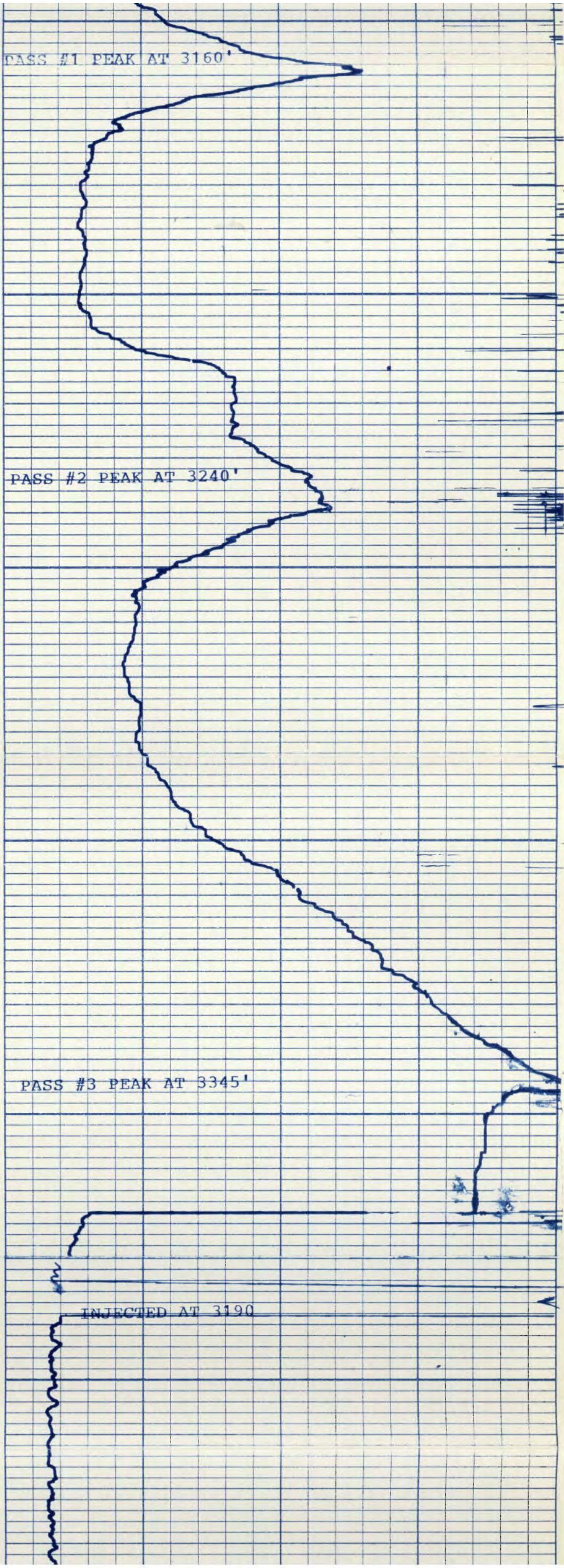
13:50





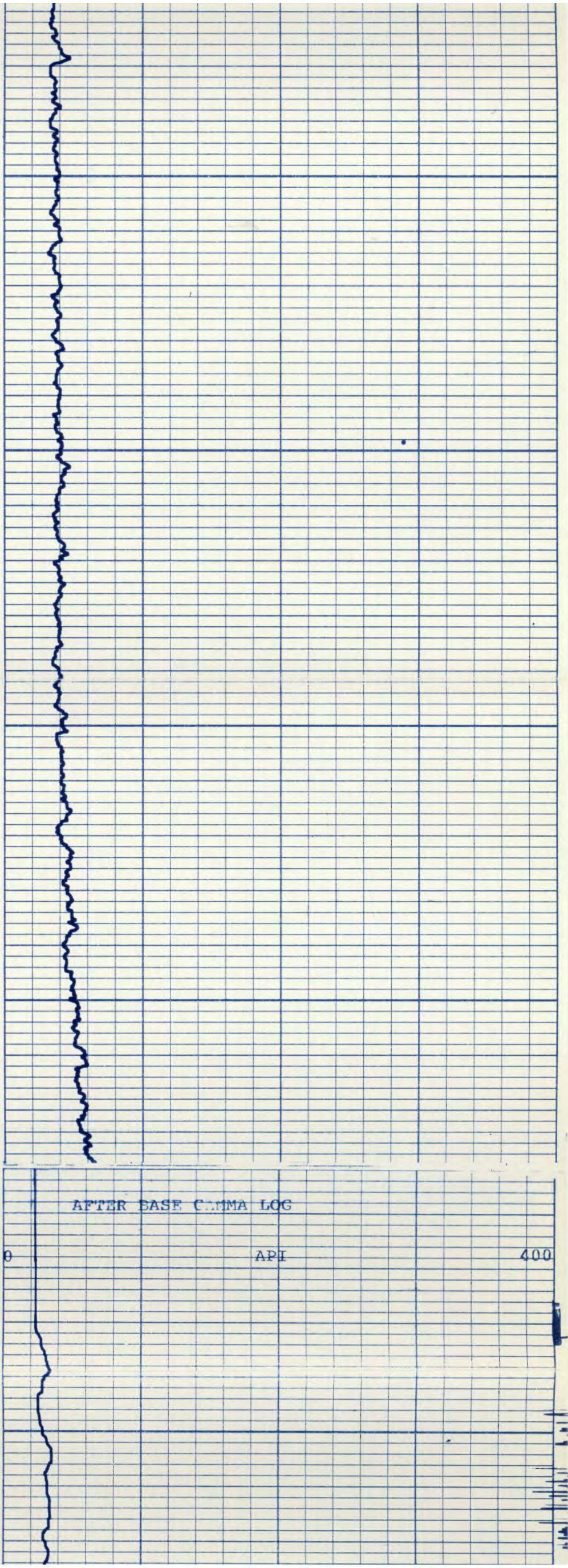
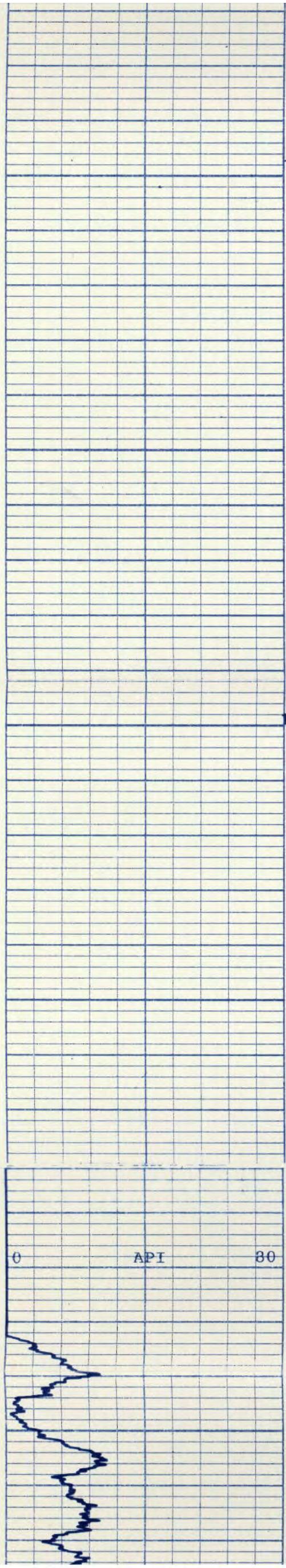
STATIONARY CHECK  
AT 3190

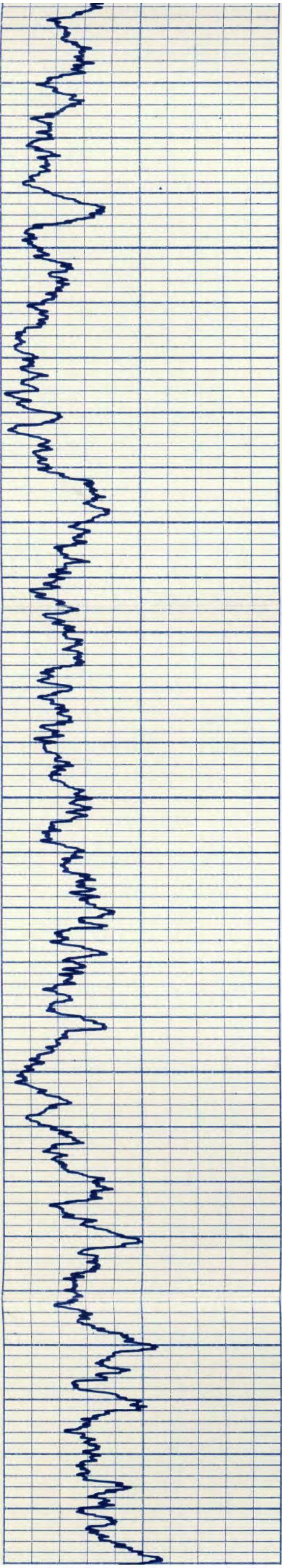
17:05



17:10

17:15

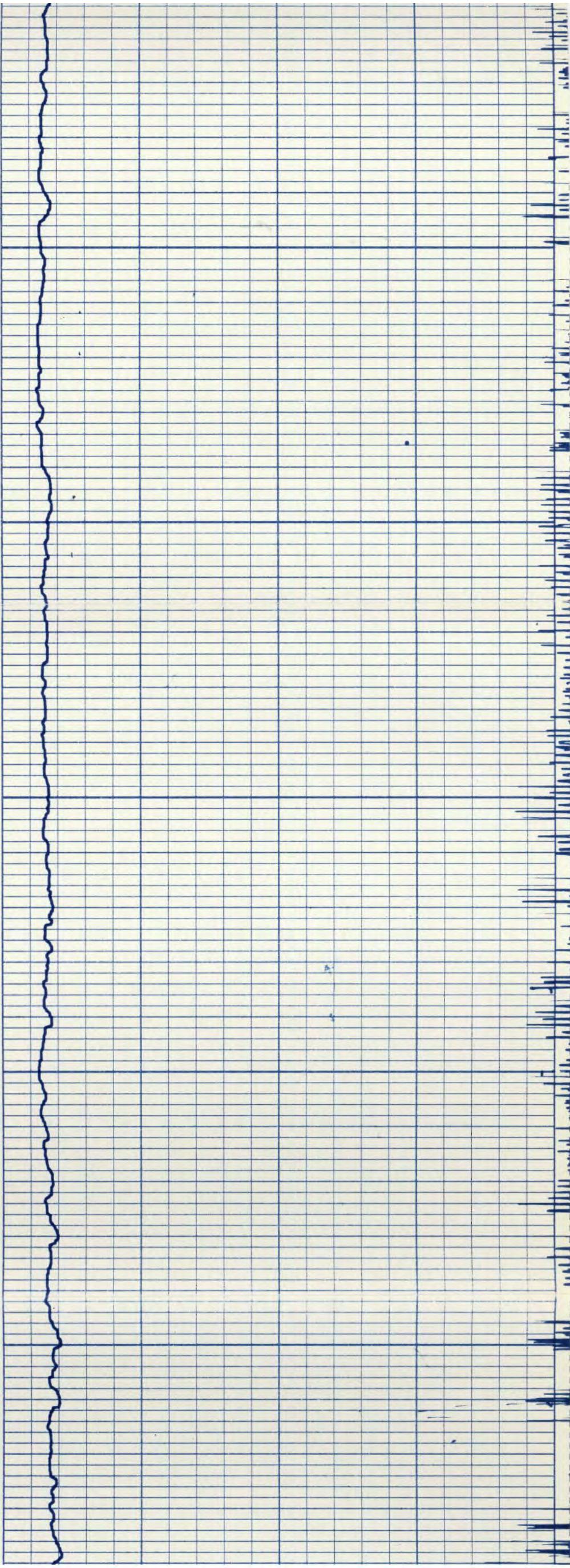


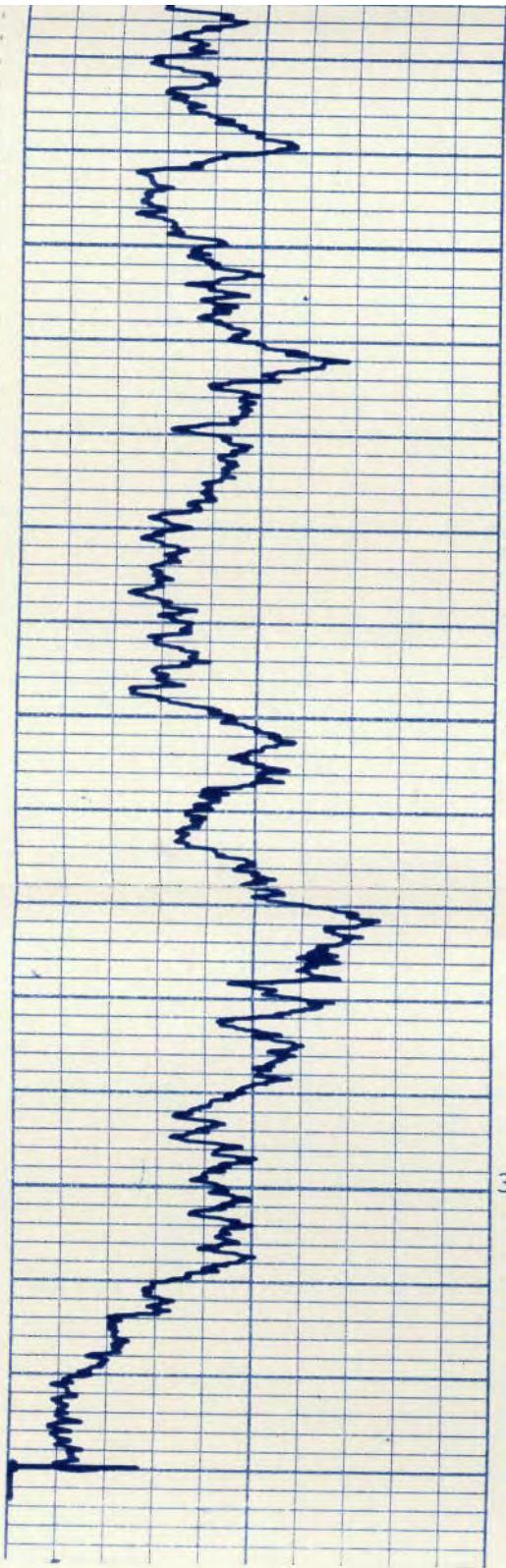


3000

3100

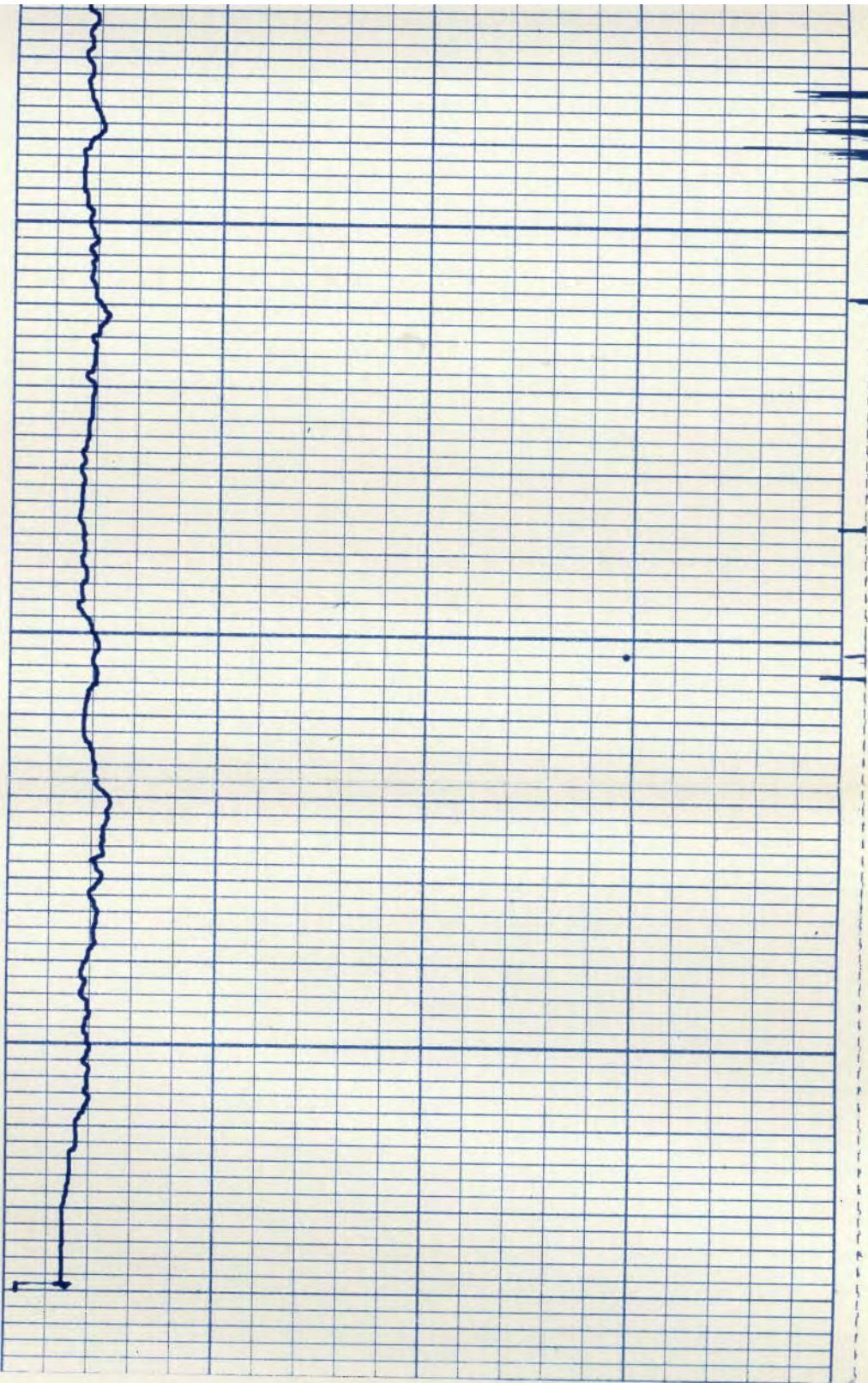
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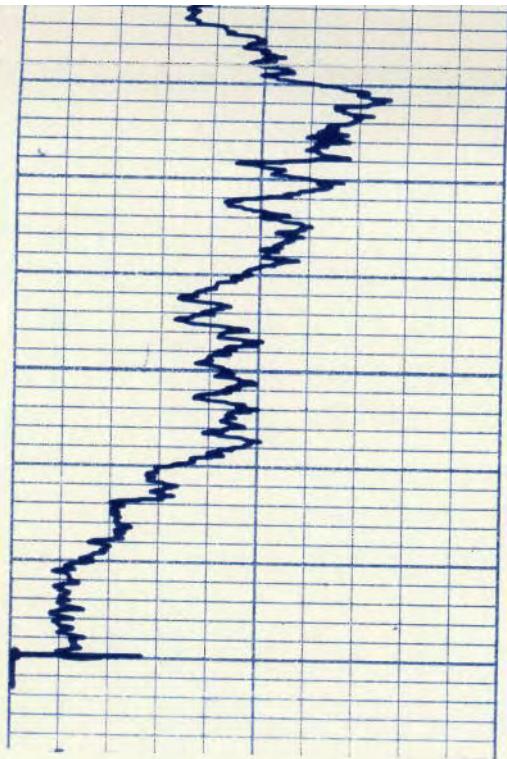




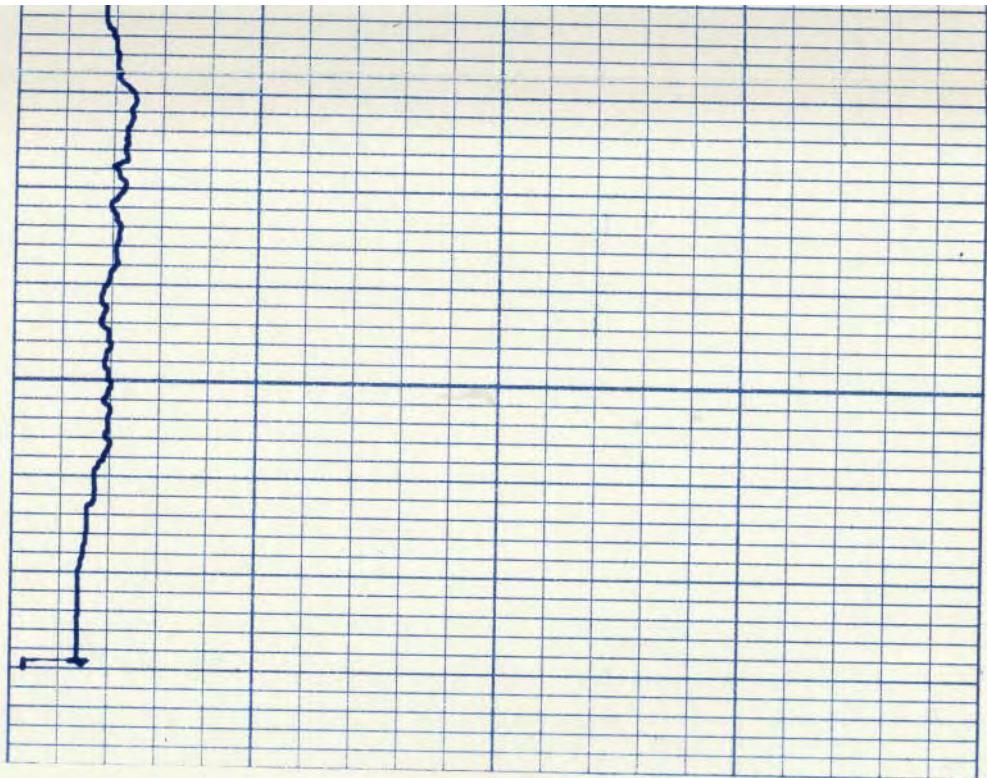
3300

3350





3350



APPENDIX B.3  
WDW-32  
GULF COAST WELL ANALYSIS LOG INTERPRETATION LETTER

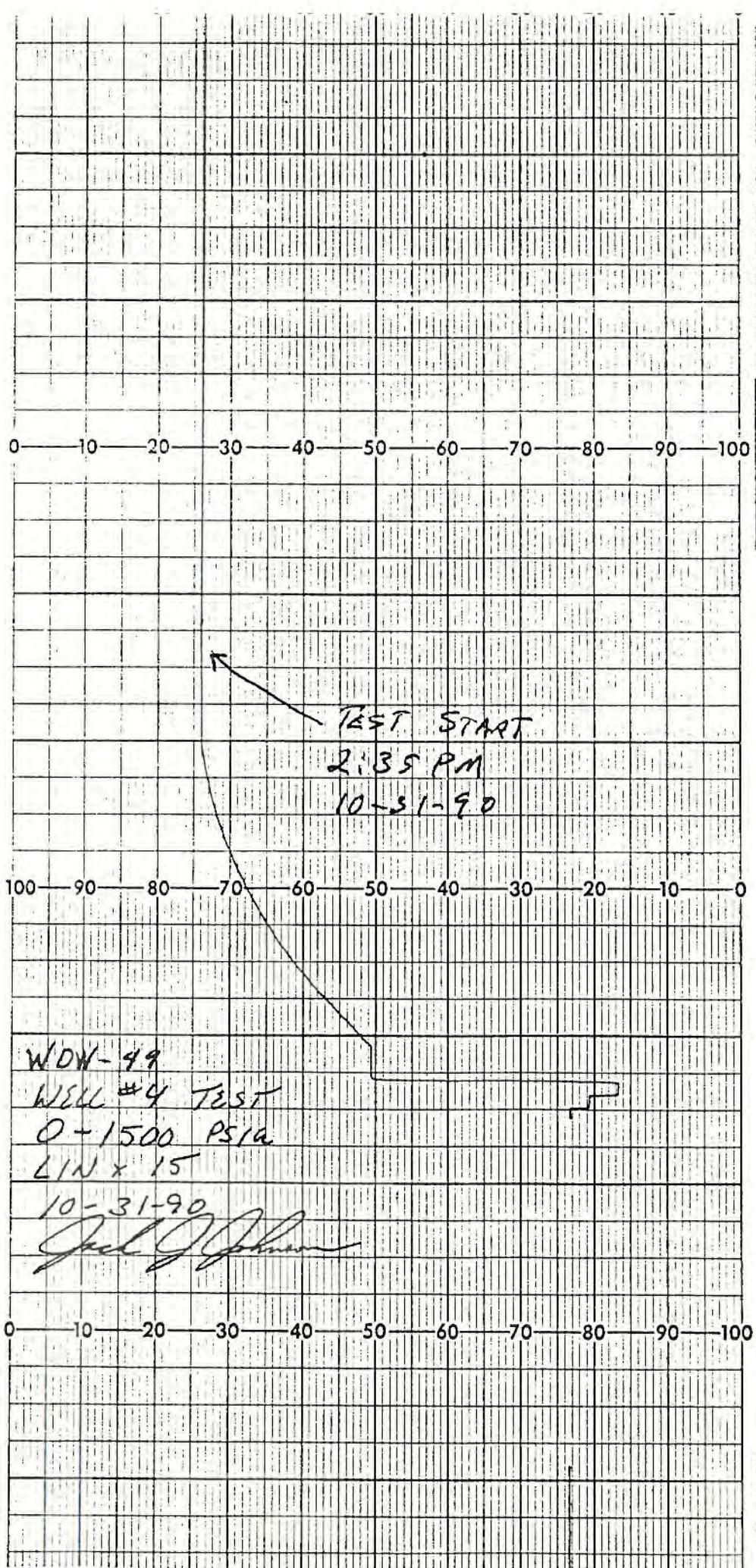


**APPENDIX C**  
**WASTE DISPOSAL WELL WDW-49**



**APPENDIX C.1**  
**WDW-49**  
**ANNULUS PRESSURE DATA**

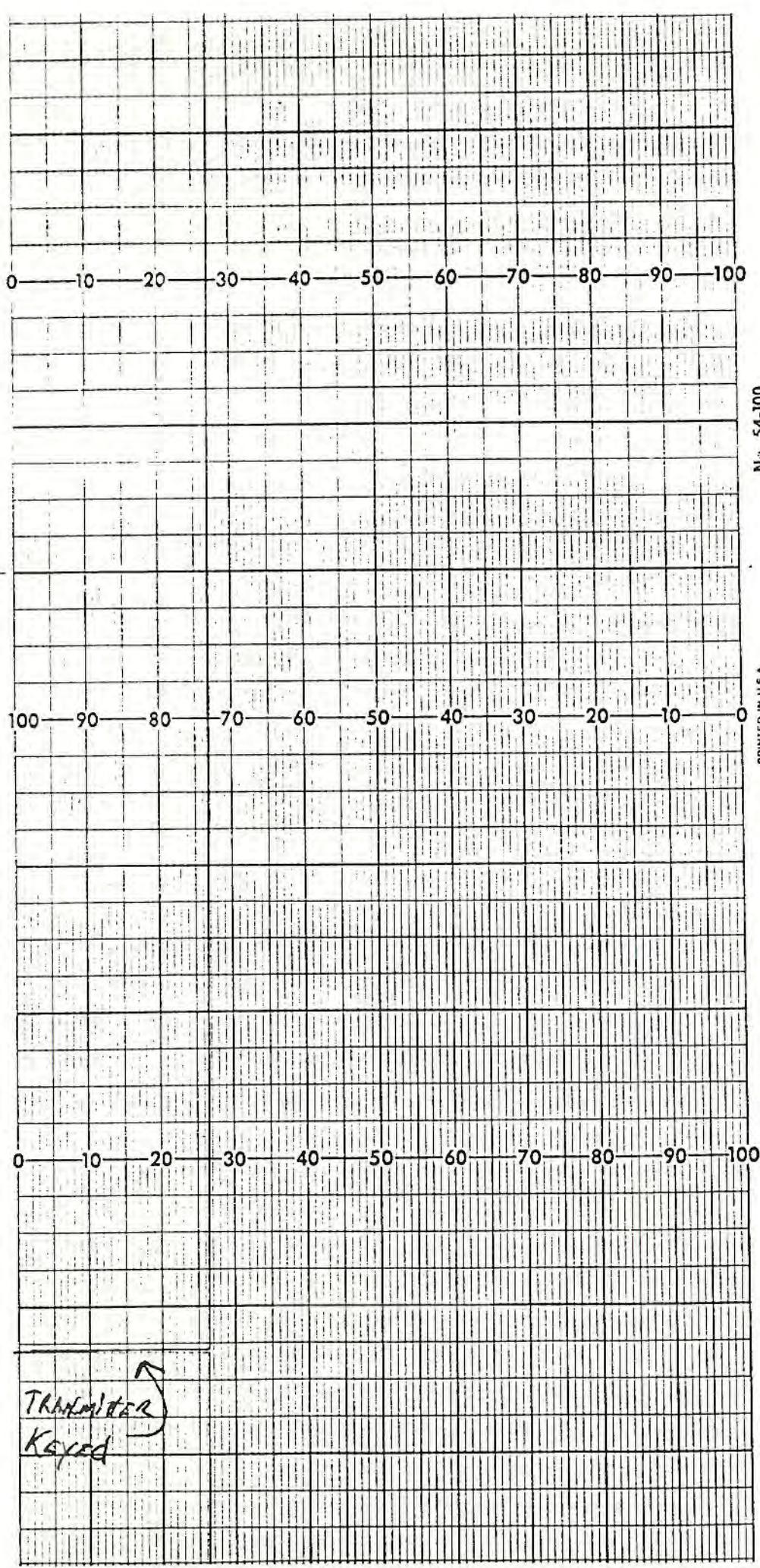




RECORDING CHARTS GRAPHIC CONTROLS CORPORATION BUFFALO, NEW YORK

WOW-49

2



No. 54-100

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WDW-49

**APPENDIX C.2**  
**WDW-49**  
**RADIOACTIVE TRACER SURVEY**



## Gulf Coast Well Analysis

RADIOACTIVE TRACER SURVEY

# Gulf Coast Well Analysis

## RADIOACTIVE TRACER SURVEY

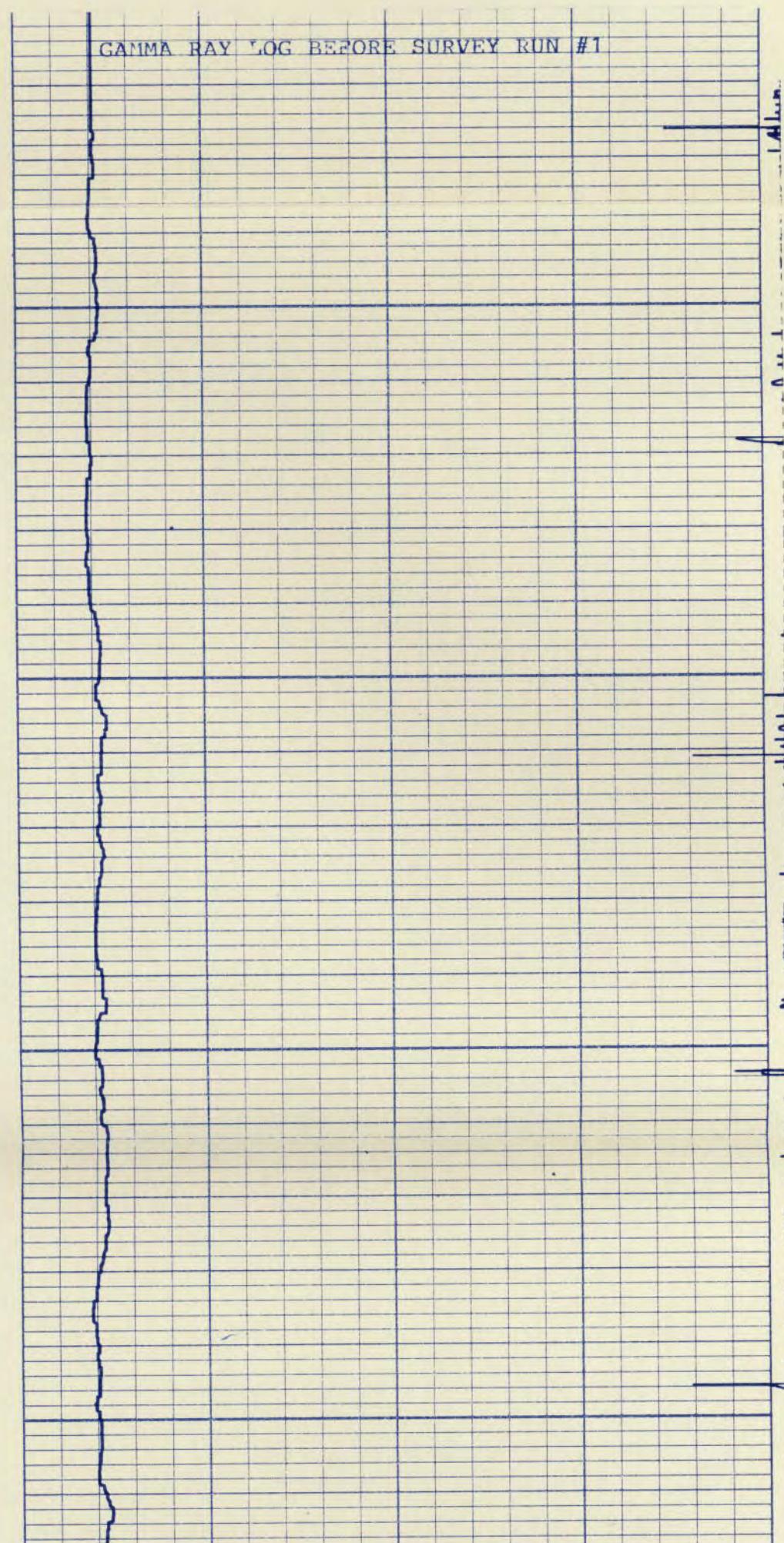
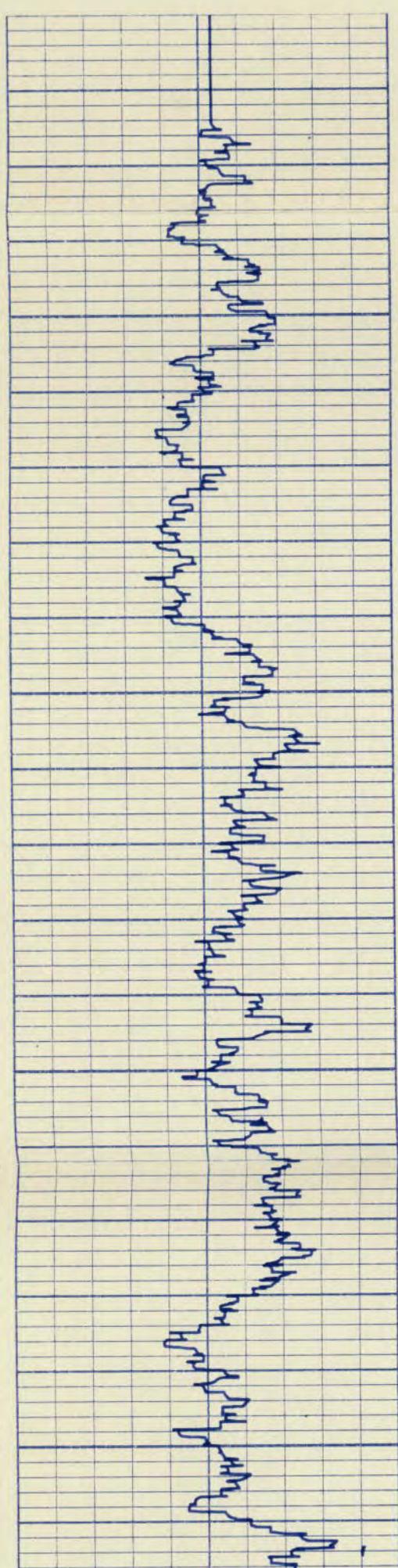
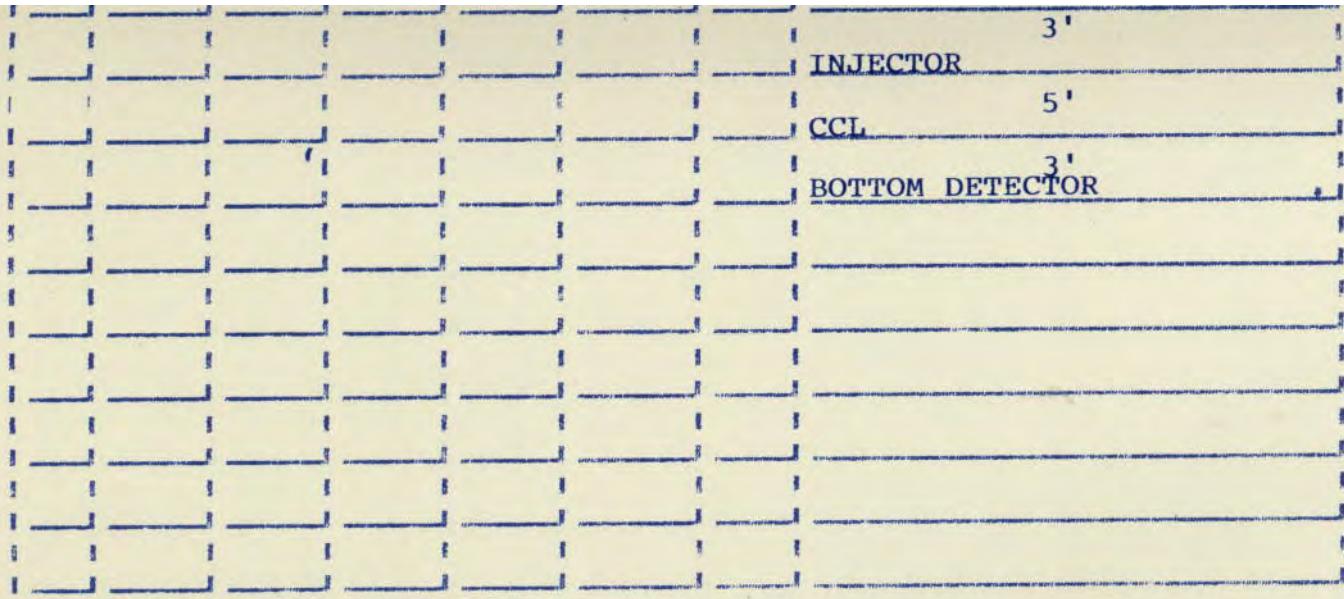
FILING NO.		COMPANY <u>HOECHST CELANESE CORPORATION</u>			
<u>PEARLAND</u>		<u>WELL</u>	<u>EFFLUENT DISPOSAL WELL #4</u>		
		<u>FIELD</u>	<u>CELANESE PLANT</u>		
		<u>COUNTY</u>	<u>MATAGORDA</u>		
		<u>LOCATION:</u>			<u>STATE</u> <u>TEXAS</u>
SEC.	NA	TWP.	NA	RGE.	NA
PERMANENT DATUM:		GROUND LEVEL		ELEV.	NA
LOG MEASURED FROM		17		FT ABOVE PERM. DATUM	ELEV.: K.B. NA
DRILLING MEASURED FROM		KELLY BUSHING			D.F. NA
Date	OCT. 31, 1990				G.L. NA
Run No.	ONE				
Type Log	R.A.T.				
Depth Driller	NA				
Depth Logger	3439				
Bottom logged interval	3435				
Top logged interval	3000				
Type fluid in hole	WASTE				
Max rec. temp., deg. F.	NA				
Operating rig time	MAST				
Recorded by	LAVERGNE				
Witnessed by	MR. R. HALL				
Bore-Hole Record			Tubing Record		
Run No.	Bit	From	To	Size	Wgt.
					From
					To
Casing Record			Liner		
Size	Wgt.	From	To	Size	Wgt.
					From
					To

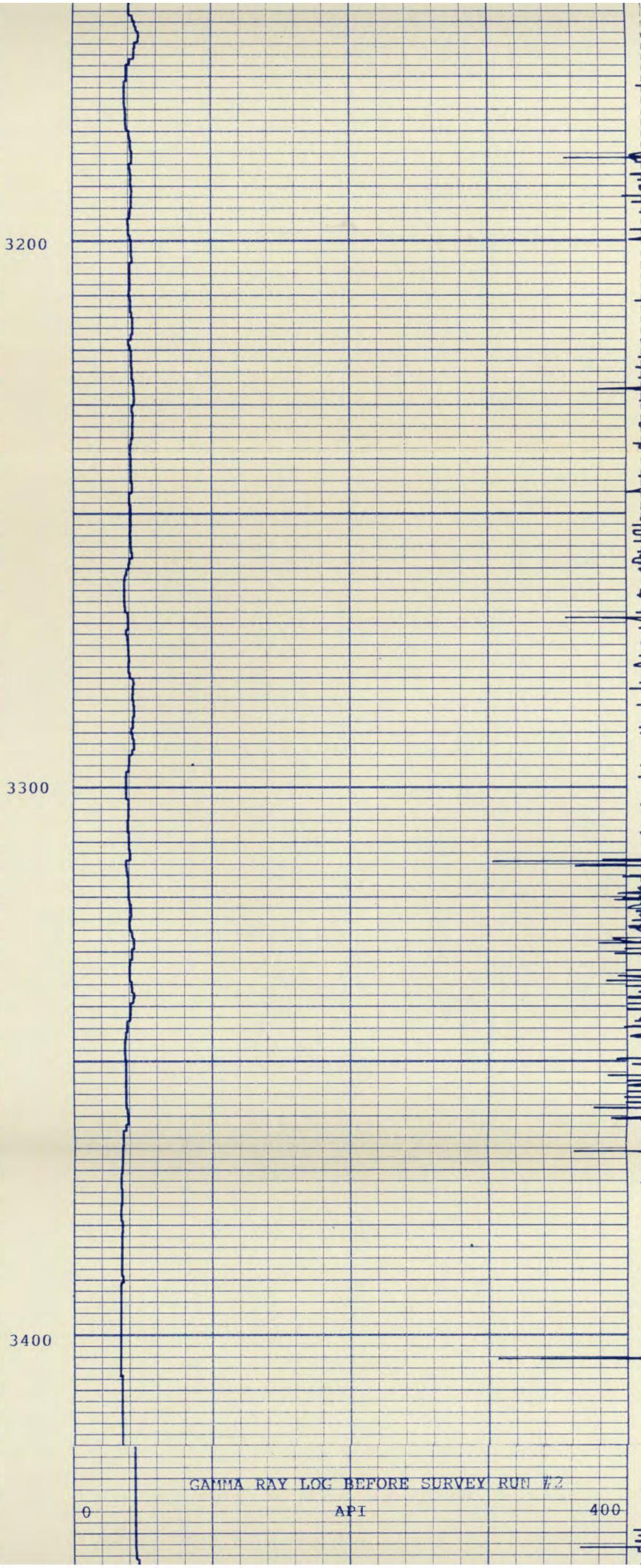
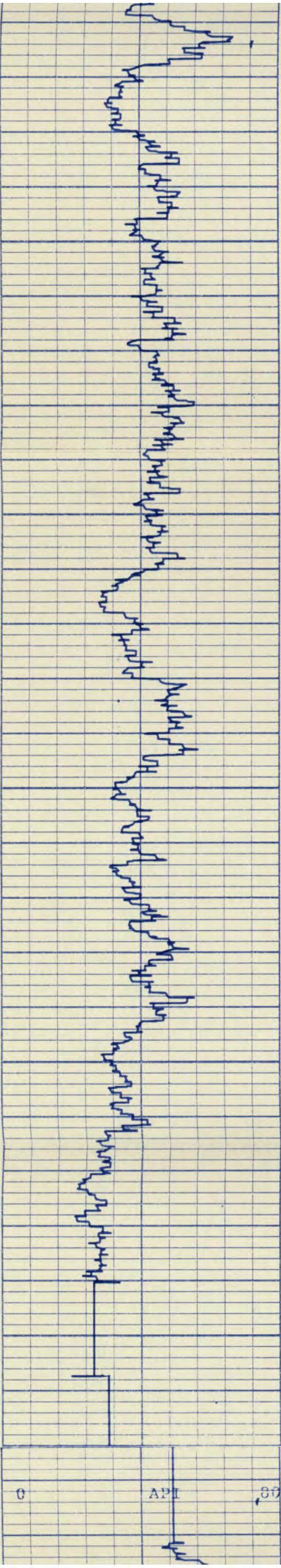
**NOTICE:** All interpretations are opinions based on inferences from electrical or other measurements and we cannot, and do not, guarantee the accuracy or correctness of any interpretations, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages or expenses incurred or sustained by anyone resulting from any interpretation made by one of our officers, agents or employees. These interpretations are also subject to our General Terms and Conditions as set out in our current Price Schedule.

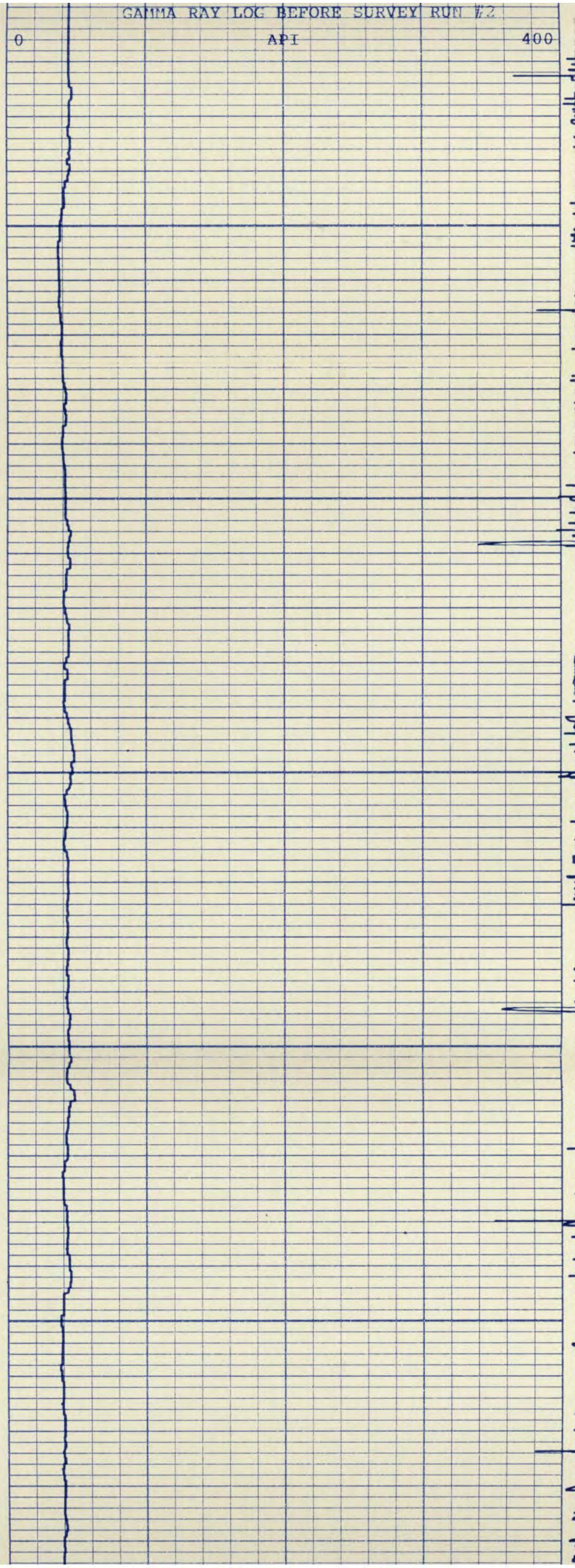
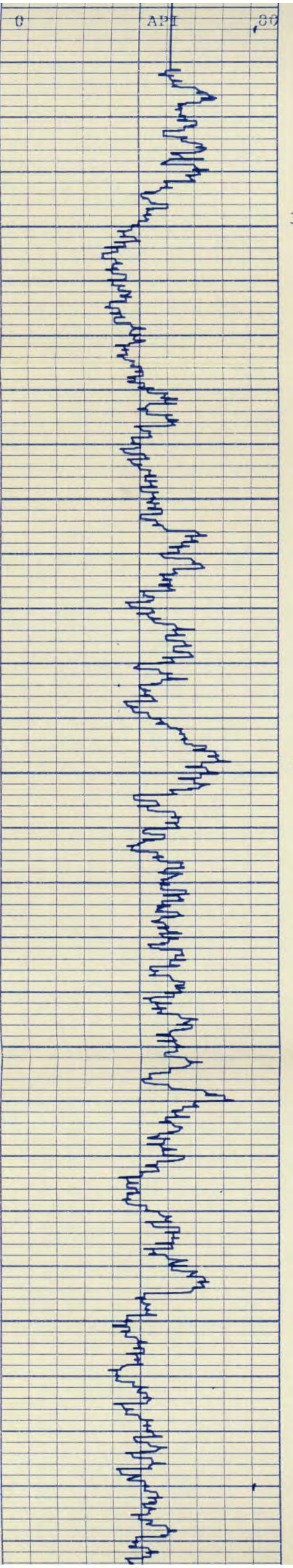
Gulf Coast Well Analysis

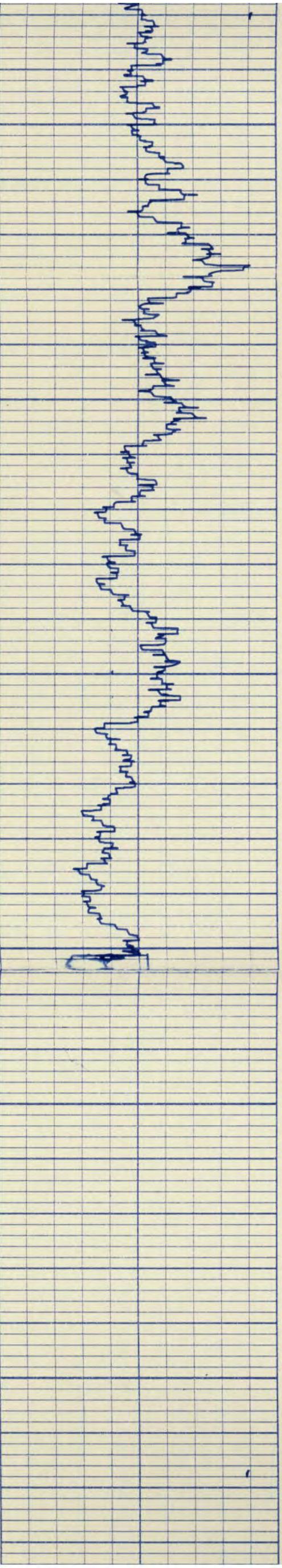
BODIPACITIVE TRACER LOG SUMMARY SHEET

Run	Time	Depth	Rate	TC	Description
1	10:30	11:00	2980	3390	STATIC GAMMA RAY LOG BEFORE SURVEY 1
2	11:05	11:25	2980	3390	STATIC GAMMA RAY LOG BEFORE SURVEY 2
3	11:25	11:30		3330	STATIC STATISTICAL CHECK AT 3330
4	11:30	11:35		3330	STATIC STATISTICAL CHECK AT 3330
5	11:40	11:45		3302	STATIC STATISTICAL CHECK AT 3302
6		12:00	3000	3000	60 GPM INJECTED 5 SEC. AT 10 MCI.
7			3062	60 GPM	3 PASS #1 PEAK AT 3062'
8			3151	60 GPM	3 PASS #2 PEAK AT 3152'
9			3239	60 GPM	3 PASS #3 PEAK AT 3239'
10			3306	60 GPM	3 PASS #4 PEAK AT 3306'
11	12:30	13:10		3330	60 GPM 3 STATIONARY CHECK AT 3330' 40 MIN.
12	13:20	13:45	3000	3380	60 GPM GAMMA RAY LOG AFTER SURVEY





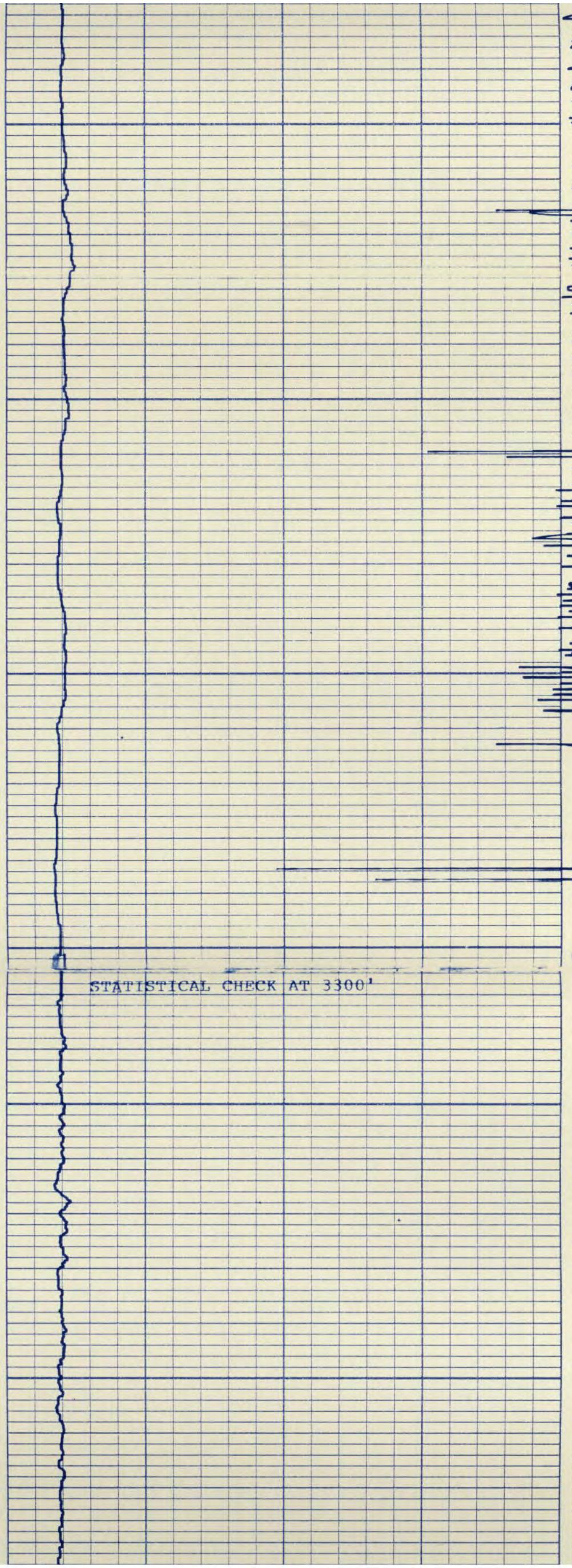




3300

3400

11:25



11:30

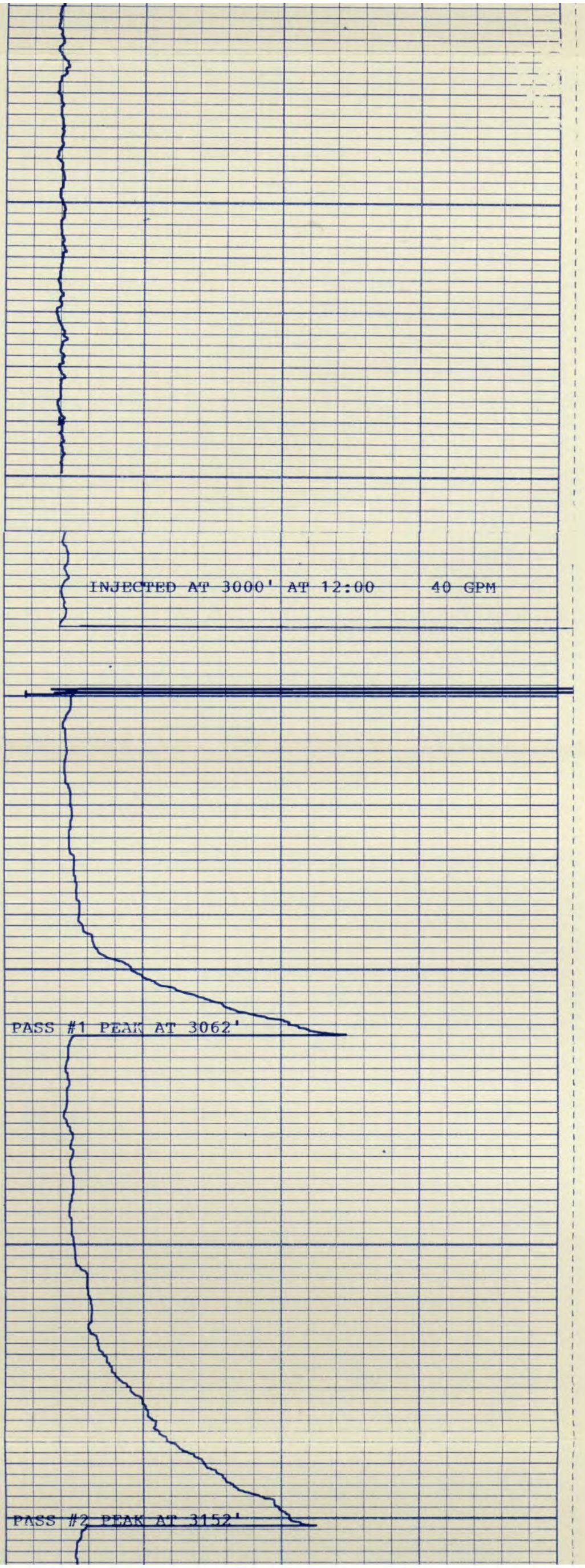
STATISTICAL CHECK AT 3330

11:30

11:35

STATISTICAL CHECK AT 3302

11:40



11:45

3000

3100

PASS #2 PEAK AT 3152'

3200

PASS #3 PEAK AT 3239'

3300

PASS #4 PEAK AT 3306'

3400

3400

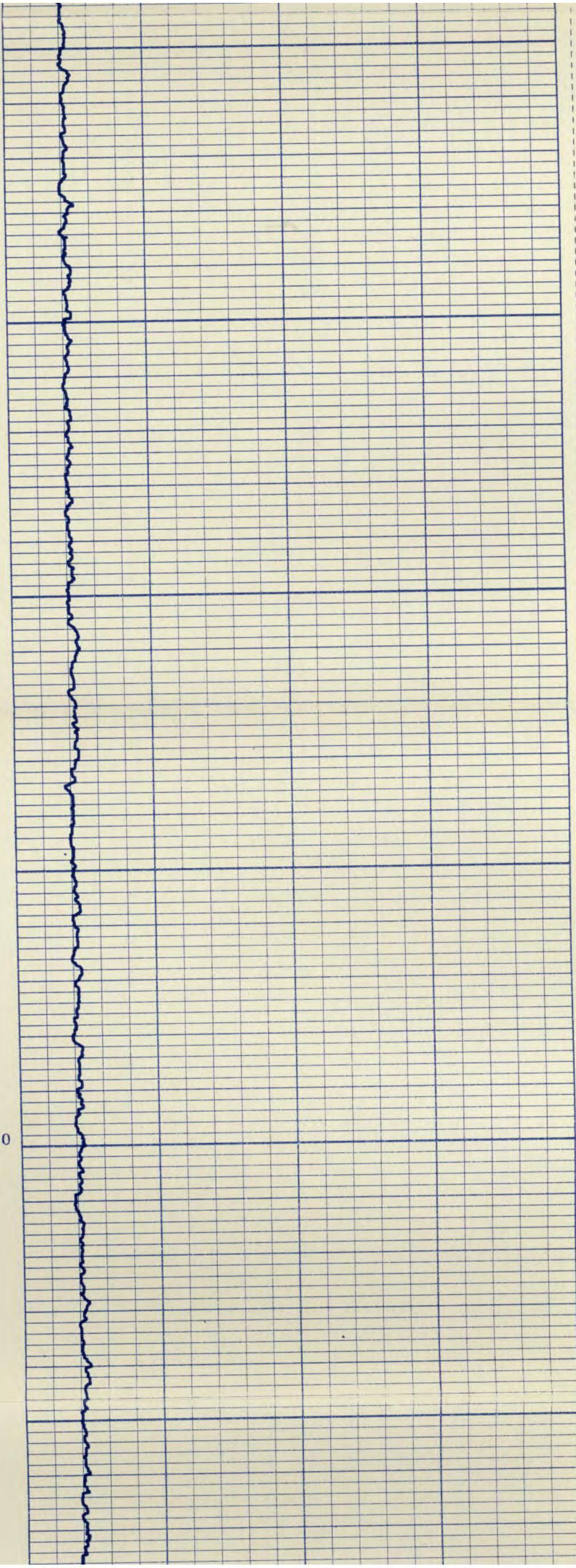
STATIONARY CHECK AT 3330 40 MIN.

12:30

12:35

12:40

12:40



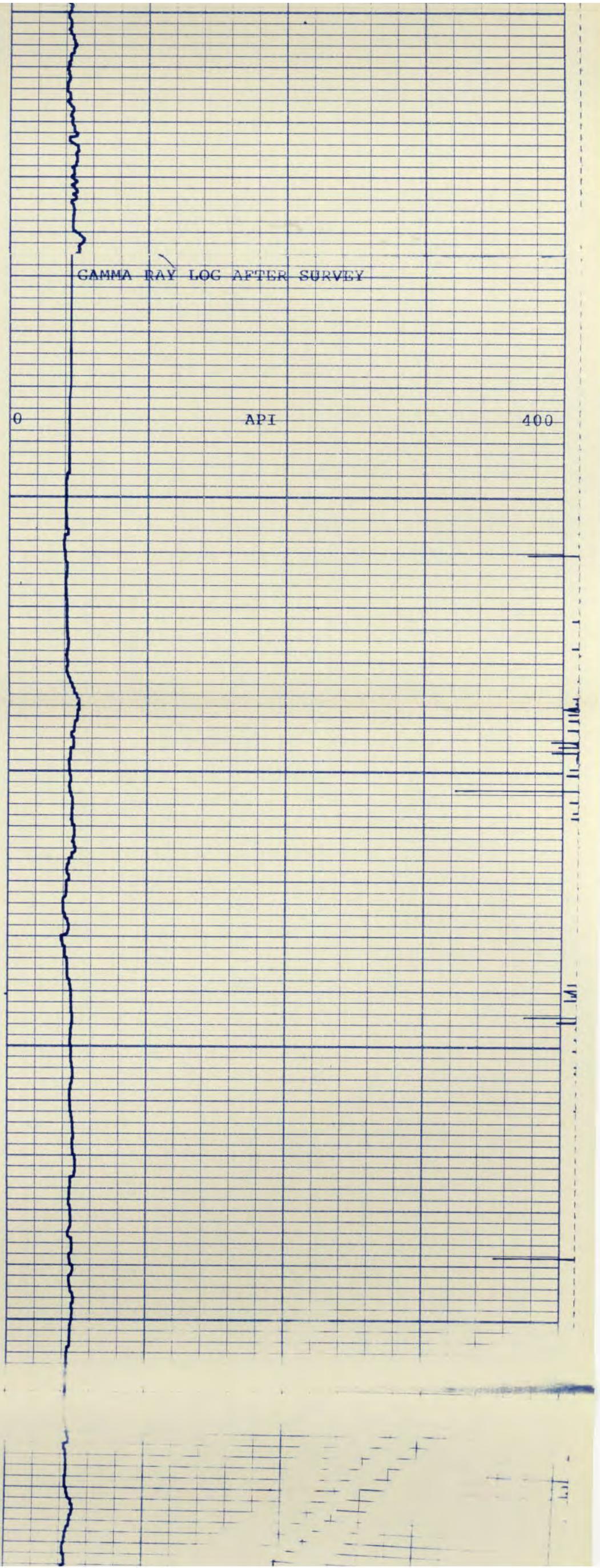
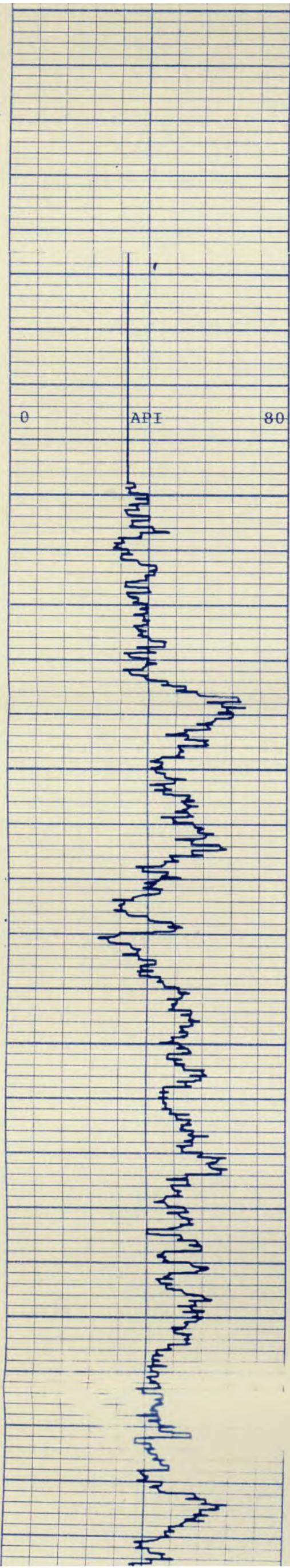
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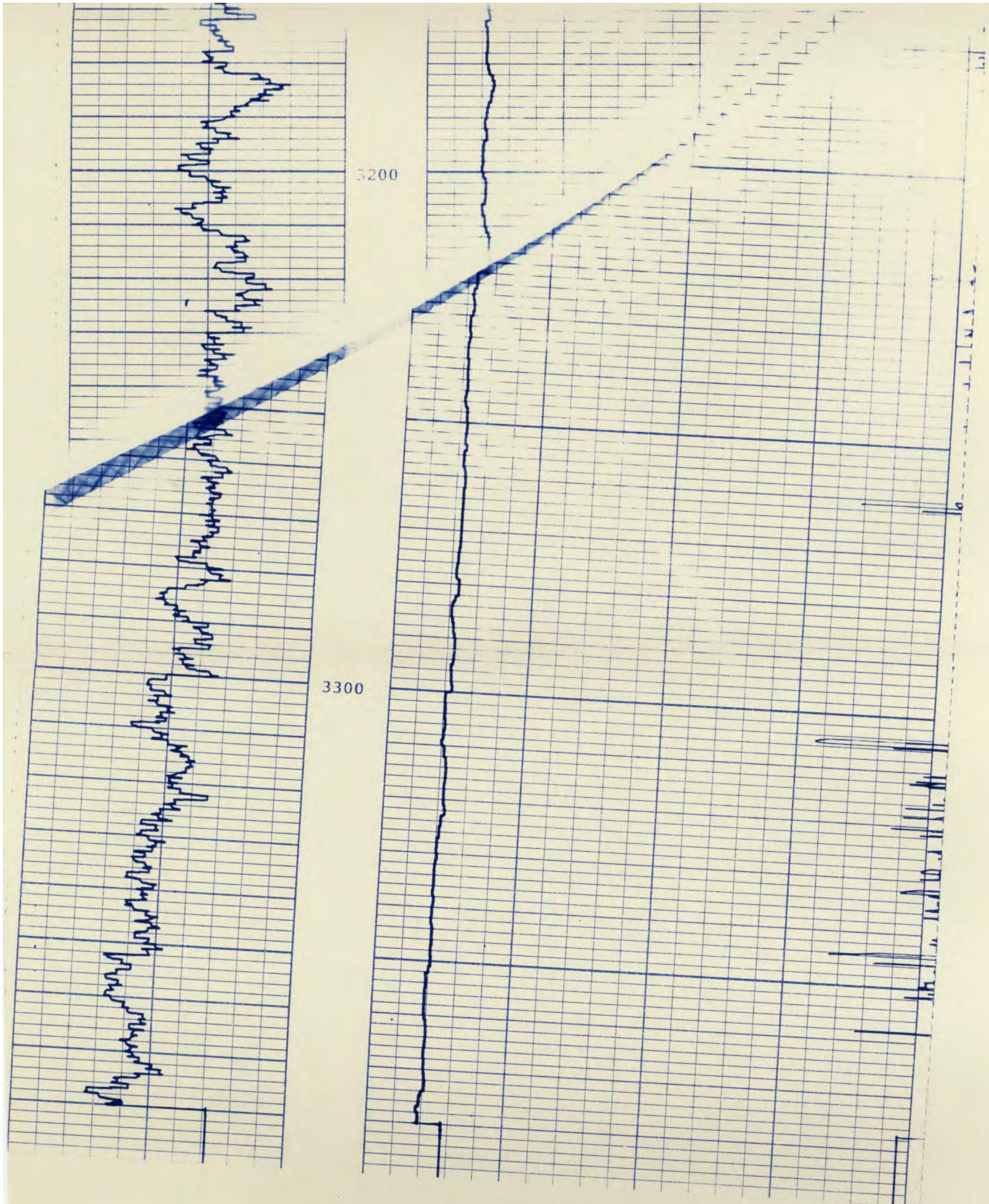
12:50

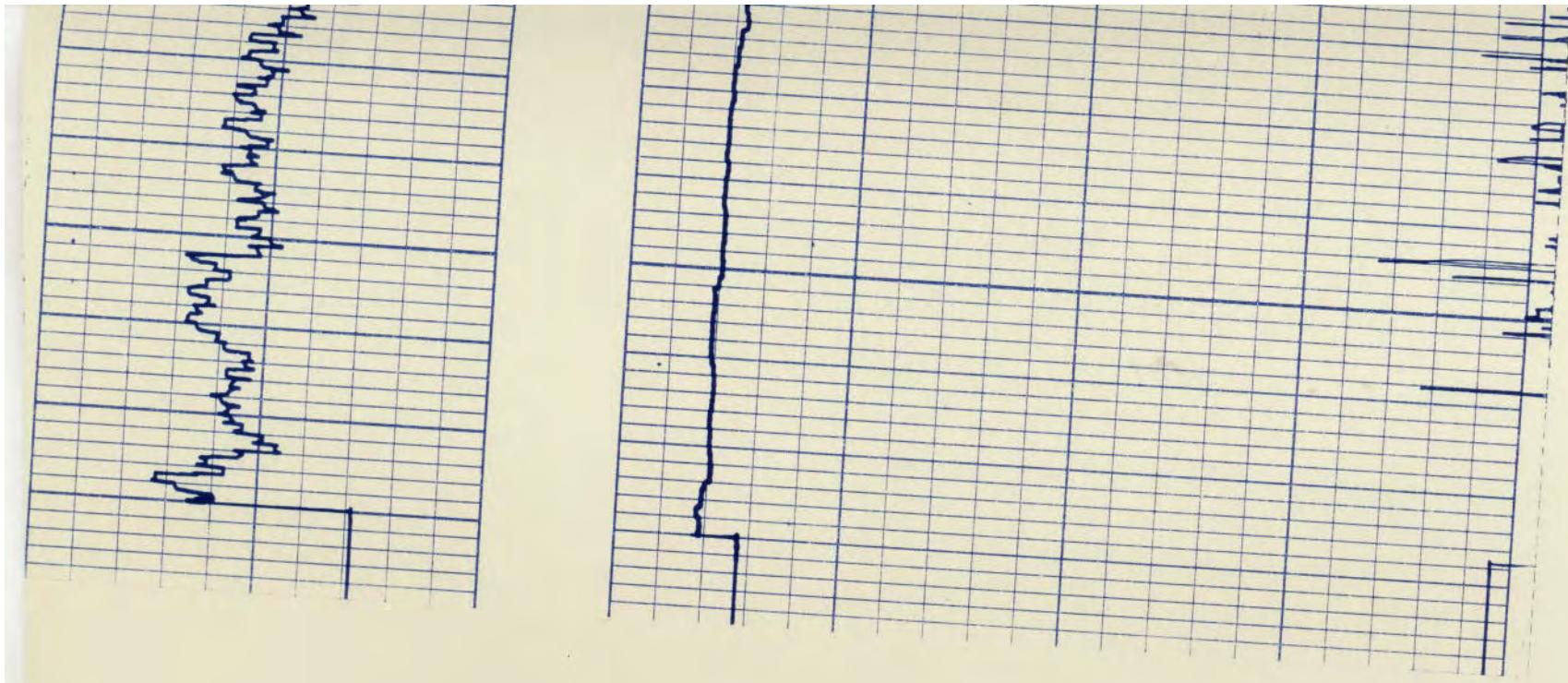
12:55

13:00

13:05







**APPENDIX C.3**  
**WDW-49**  
**GULF COAST WELL ANALYSIS LOG INTERPRETATION LETTER**



**APPENDIX D**  
**WASTE DISPOSAL WELL WDW-110**



**APPENDIX D.1**  
**WDW-110**  
**ANNULUS PRESSURE DATA**



10:02 AM

No. 54-100

1

charging bottles

PRINTED IN U.S.A.

100 90 80 70 60 50 40 30 20 10 0

0 10 20 30 40 50 60 70 80 90 100

100% INDW-110

0%

WELL 1A TEST

0 - 1000 PSIG

LIN x 10

100 90 80 70 60 50 40 30 20 10 0

10-31 + 90

CONTROLS CORPORATION

BUFFALO, NEW YORK

Jack J Johnson

INDW-110

**GULF  
COAST  
WELL  
ANALYSIS**

**COASTAL WIRELINE SERVICES, INC.**

HOECHST CELANESE CORPORATION  
CELANESE PLANT  
MATAGORDA COUNTY, TEXAS  
EFFLUENT DISPOSAL WELL #4

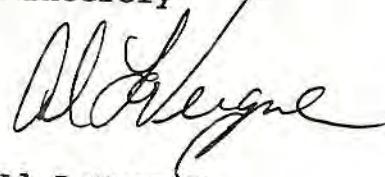
NOVEMBER 1, 1990

To whom it may concern:

Radioactive Tracer Log was run to check for channeling.

Radioactive Tracer Log indicates that all fluid is going into disposal zone at this time. No indication of leaking or channeling behind pipe. This concludes Gulf Coast Well Analysis log interpretation for Effluent Disposal Well #4.

Sincerely



Al LaVergne

2

16/01KD-110

BUFFALO, NEW YORK

GRAPHIC CONTROLS CORPORATION

GI RECORDING CHARTS

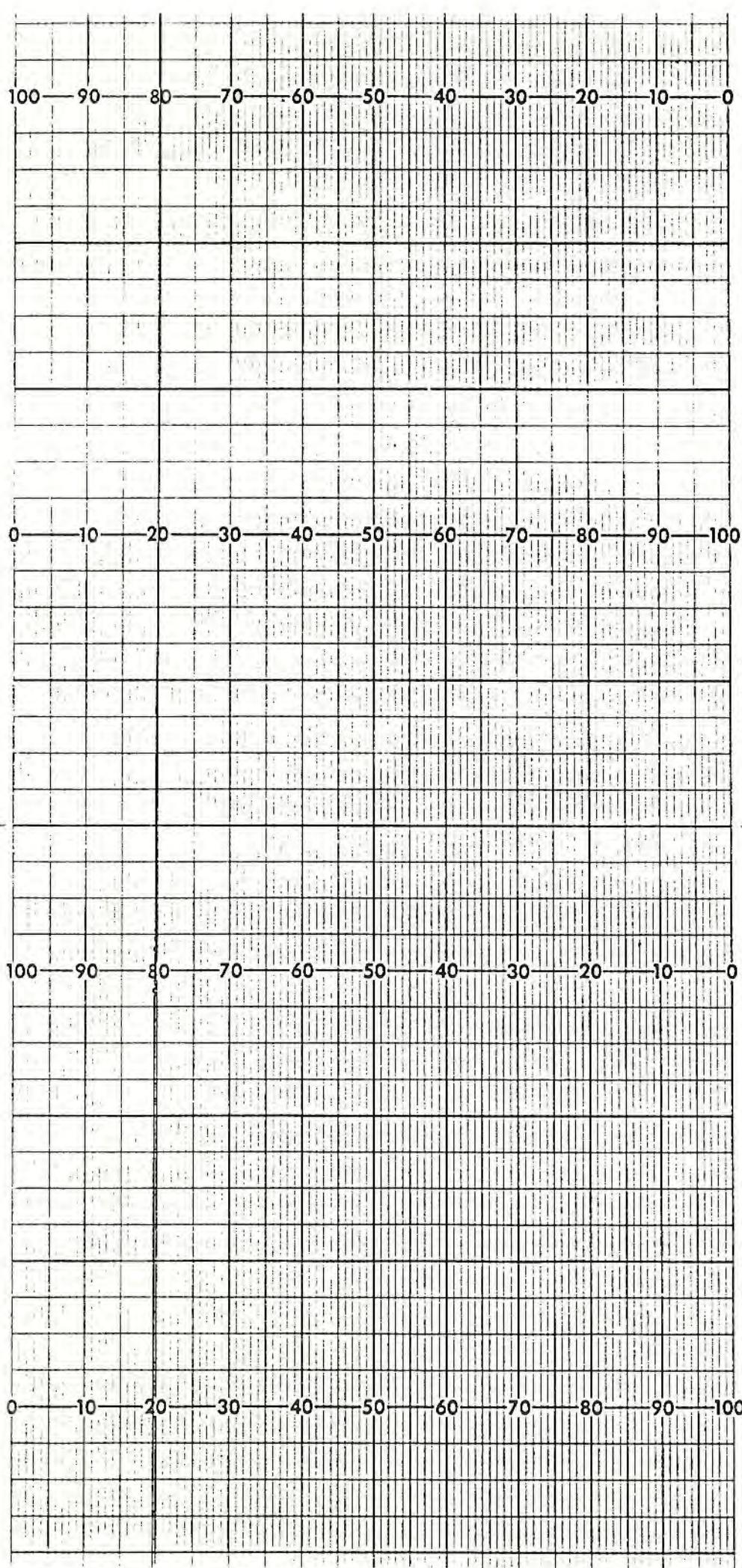
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0—10—20—30—40—50—60—70—80—90—100

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0—10—20—30—40—50—60—70—80—90—100

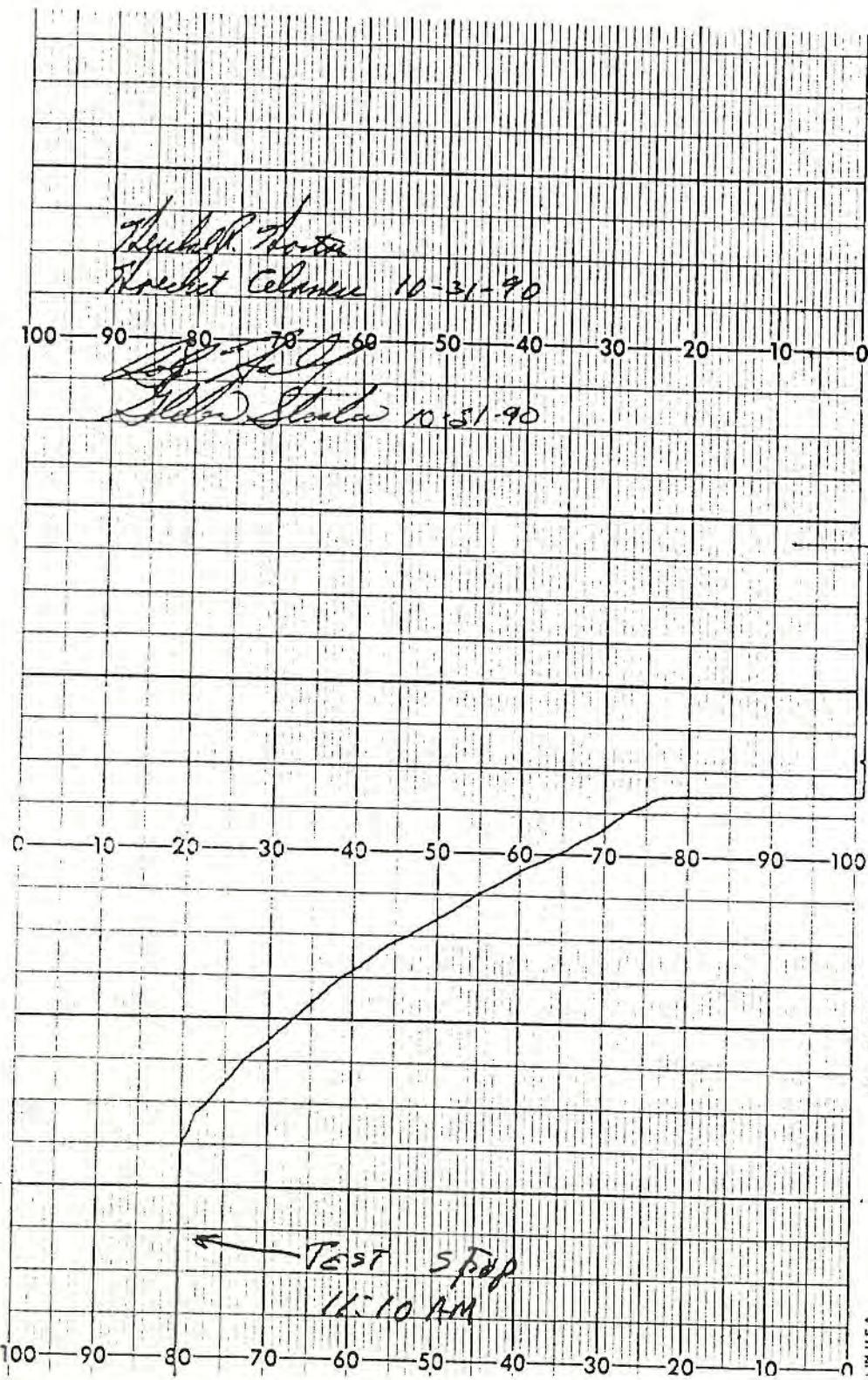




No. 54-100

PRINTED IN U.S.A.

WOW-110



**APPENDIX D.2**  
**WDW-110**  
**RADIOACTIVE TRACER SURVEY**



# Gulf Coast Well Analysis

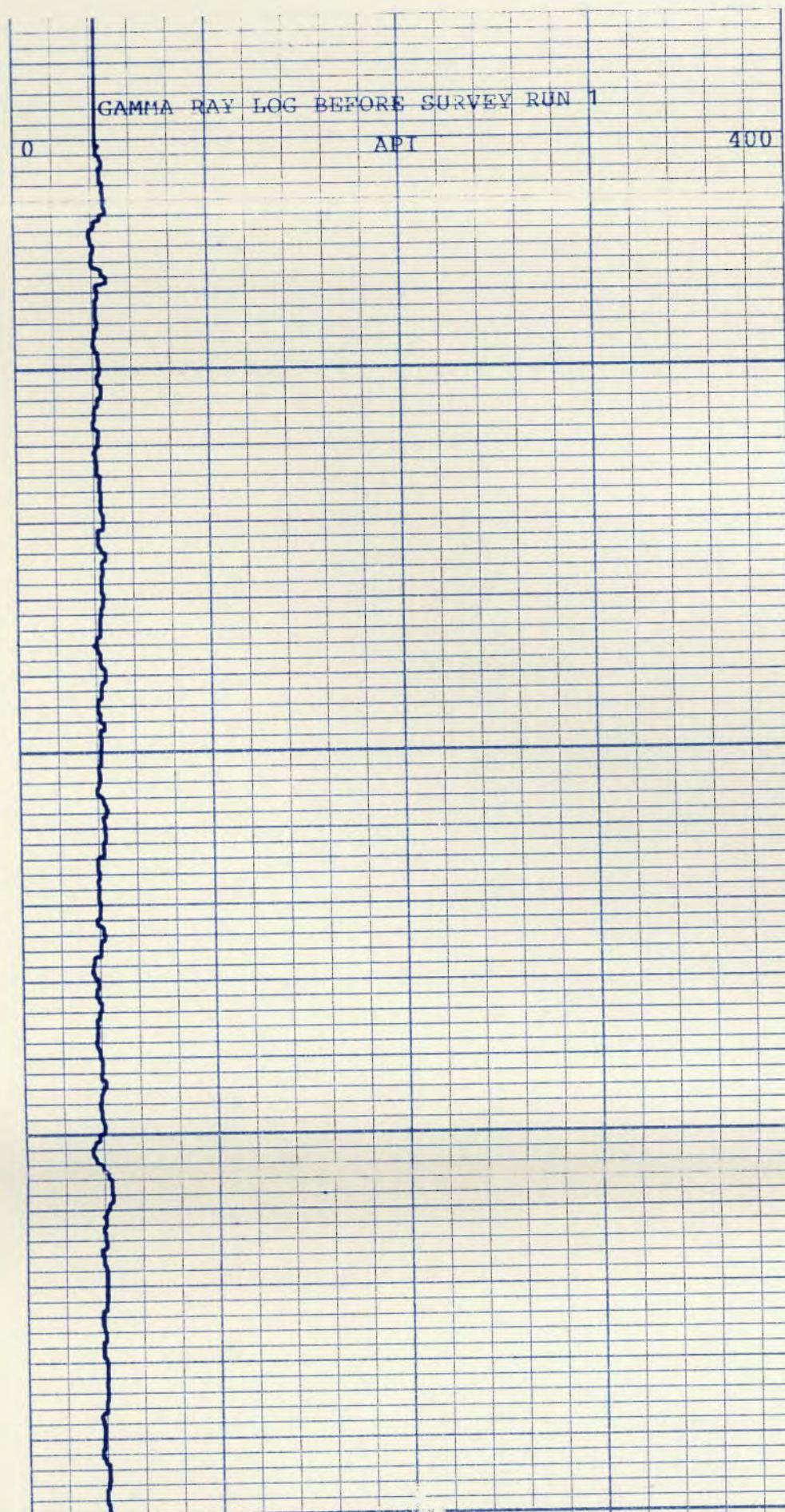
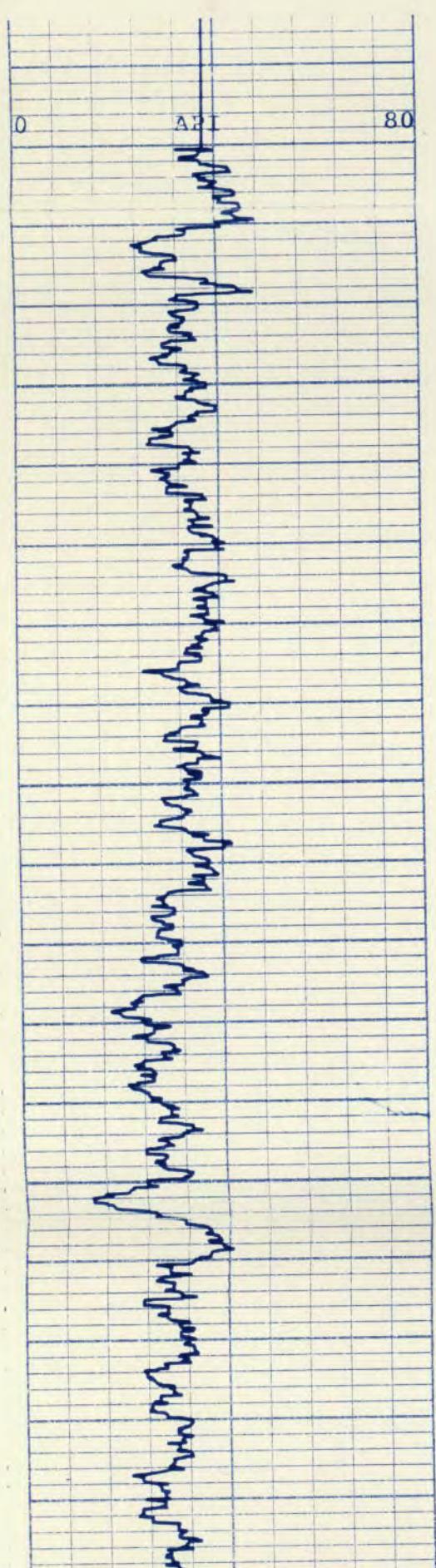
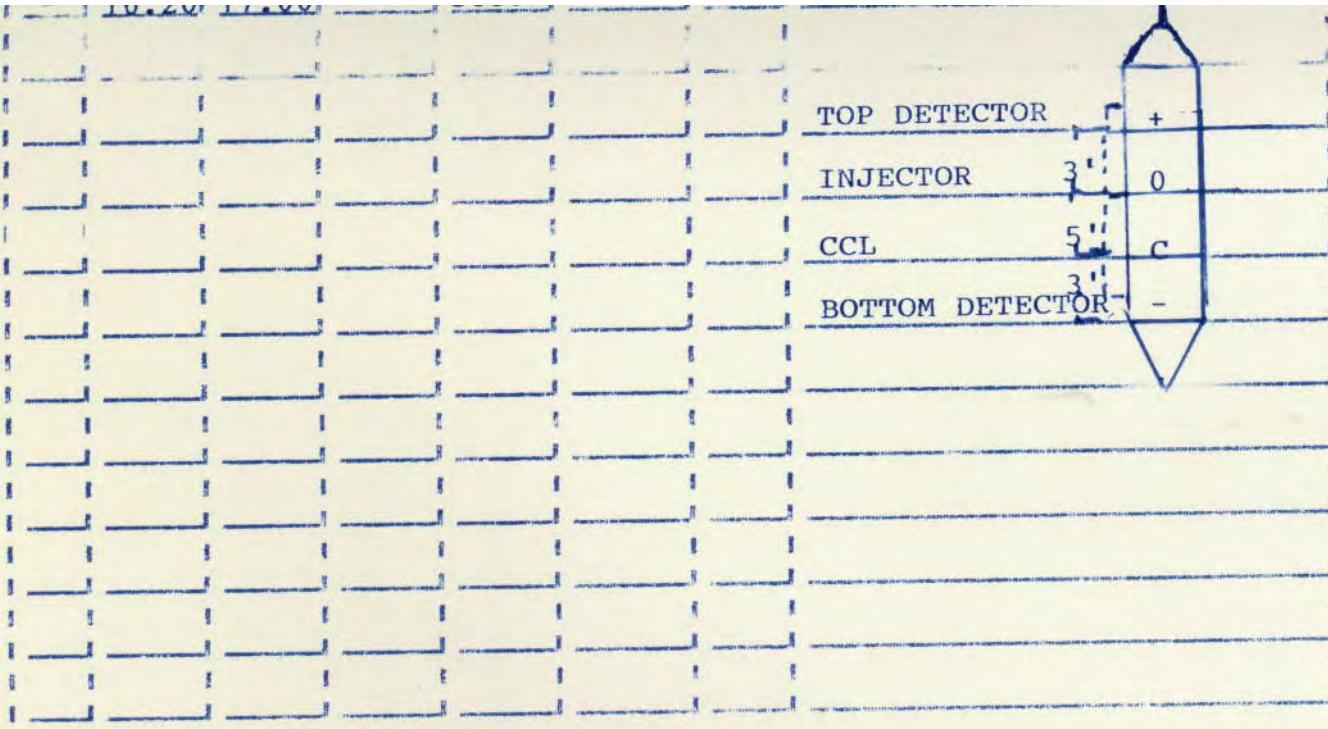
RADIOACTIVE TRACER SURVEY

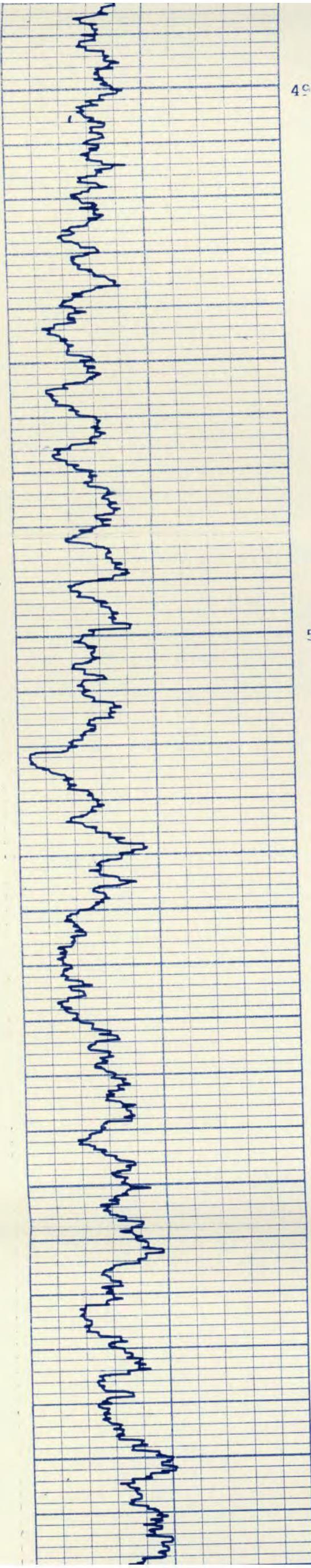
**NOTICE:** All interpretations are opinions based on inferences from electrical or other measurements and we cannot, and do not, guarantee the accuracy or correctness of any interpretations, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages or expenses incurred or sustained by anyone resulting from any interpretation made by one of our officers, agents or employees. These interpretations are also subject to our General Terms and Conditions as set out in our current Price Schedule.

Gulf Coast Well Analysis

**BODINJECTIVE TRACER LOG SUMMARY SHEET**

Run#	Time	Time	Depth	Rate	TC	Description
1	13:00	13:30	4720	5650	STATIC	GAMMA RAY LOG BEFORE SURVEY
2	13:30	14:15	4750	5650	STATIC	GAMMA RAY LOG BEFORE SURVEY
3	14:25	14:30		5000	STATIC	STATISTICAL CHECK AT 5616
4	14:35	14:40		5000	STATIC	STATISTICAL CHECK AT 5616
5		15:15		4930	50 GPM	INJECTED 5 SEC., 10 MCI.
6		15:17		5030	50 GPM	PASS #1 PEAK AT 5030'
7		15:19		5105	50 GPM	PASS #2 PEAK AT 5105'
8		15:22		5229	50 GPM	PASS #3 PEAK AT 5229'
9		15:26		5350	50 GPM	PASS #4 PEAK AT 5350'
10		15:30		5558	50 GPM	PASS #5 PEAK AT 5558'
11		15:33		5622	50 GPM	PASS #6 PEAK AT 5620'
12	15:35	16:15		5616	50 GPM	STATIONARY CHECK AT 5616'
13	16:20	17:00	4720	5650	50 GPM	GAMMA RAY LOG AFTER SURVEY

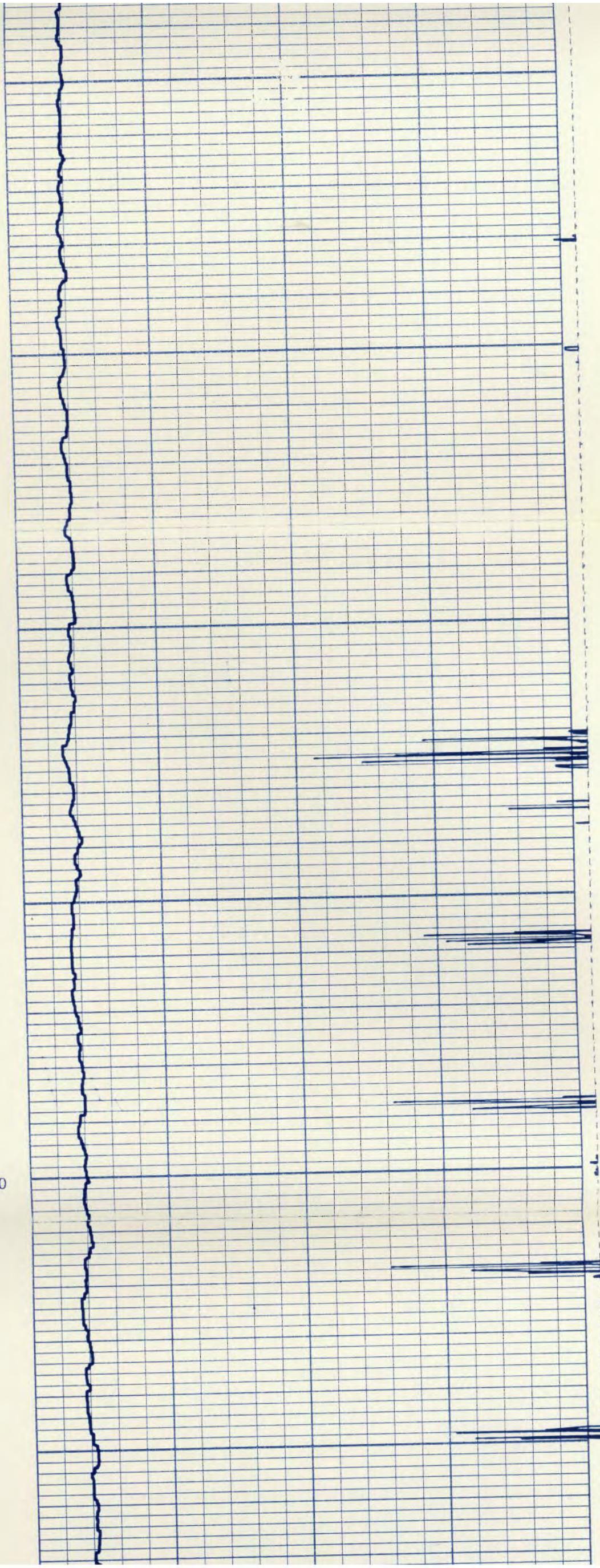


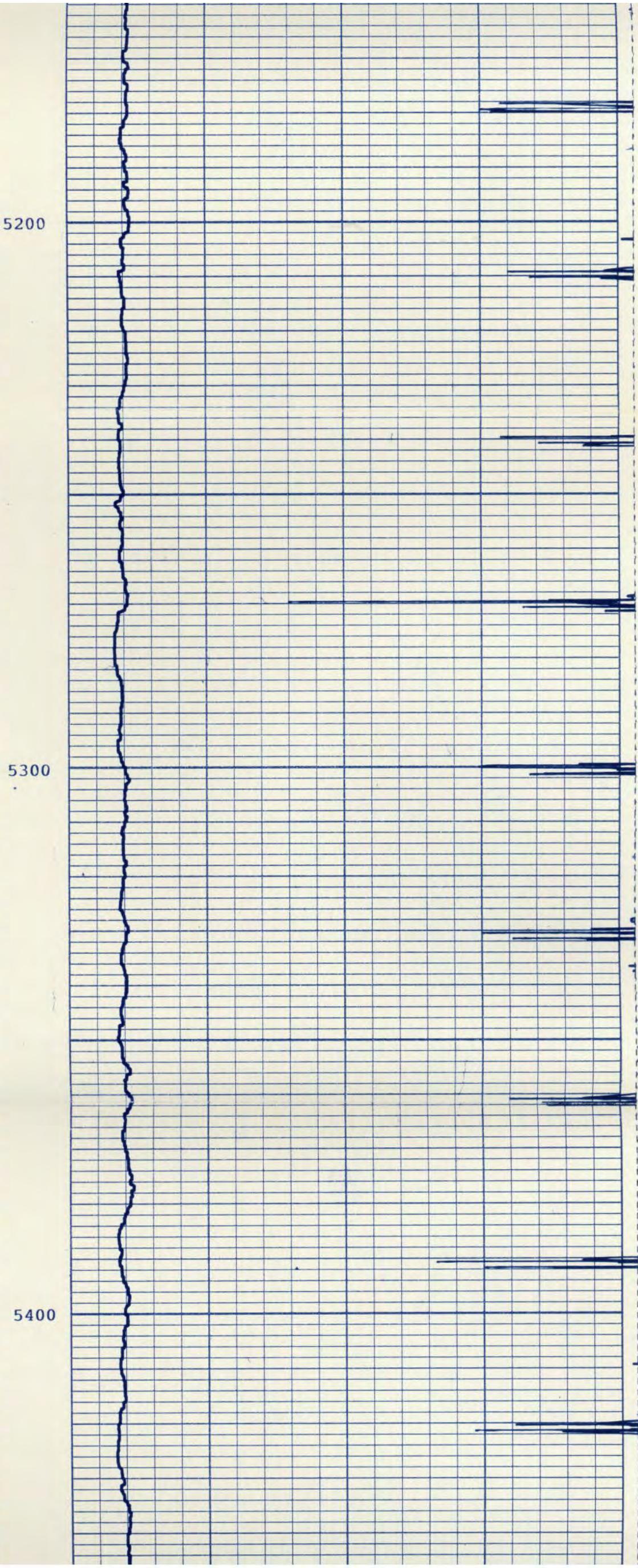
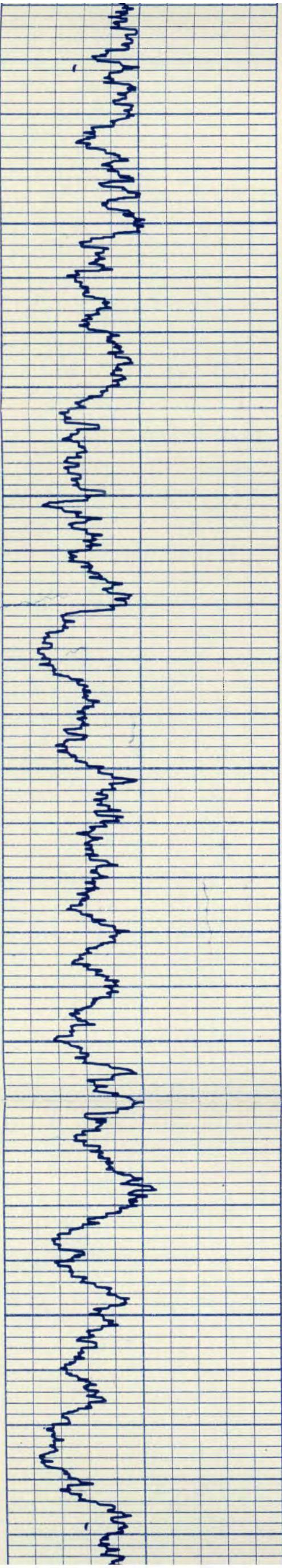


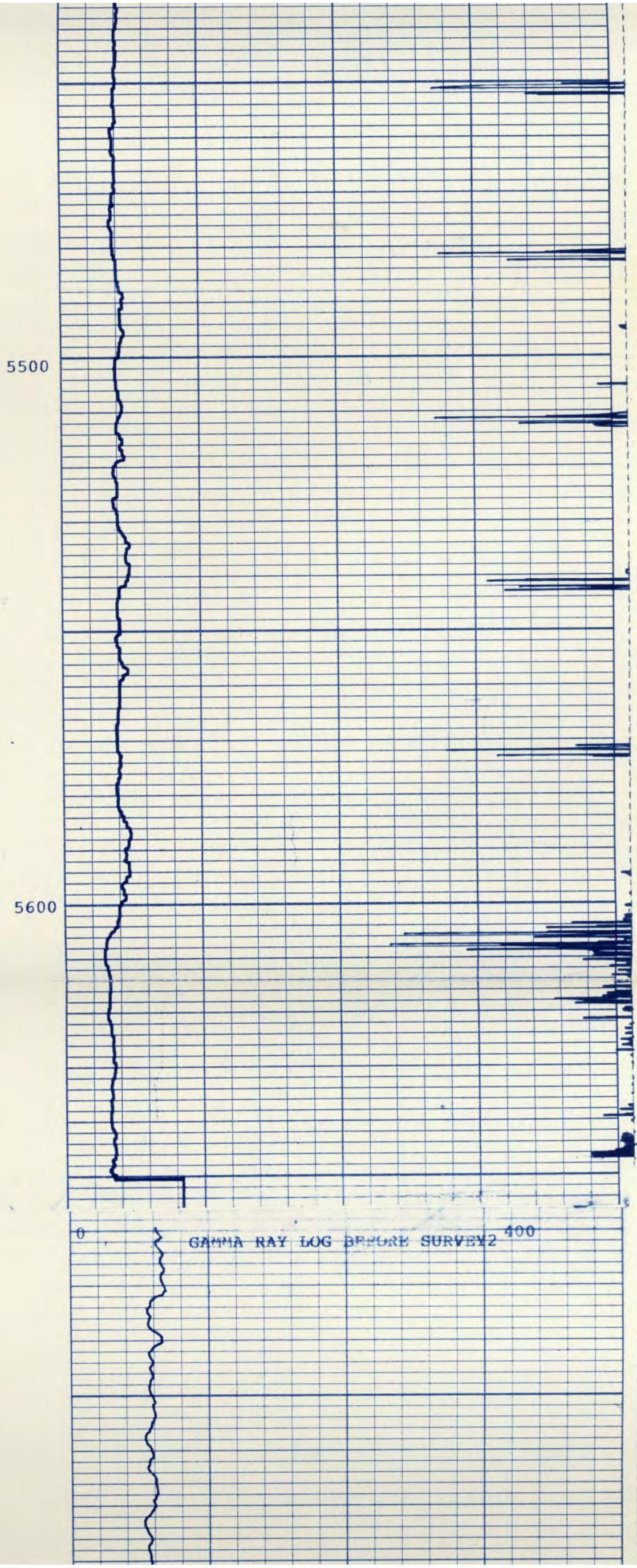
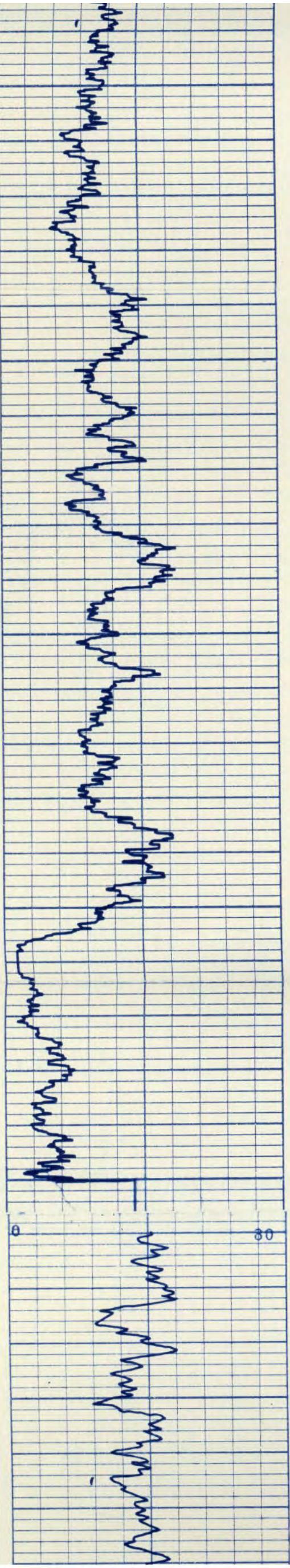
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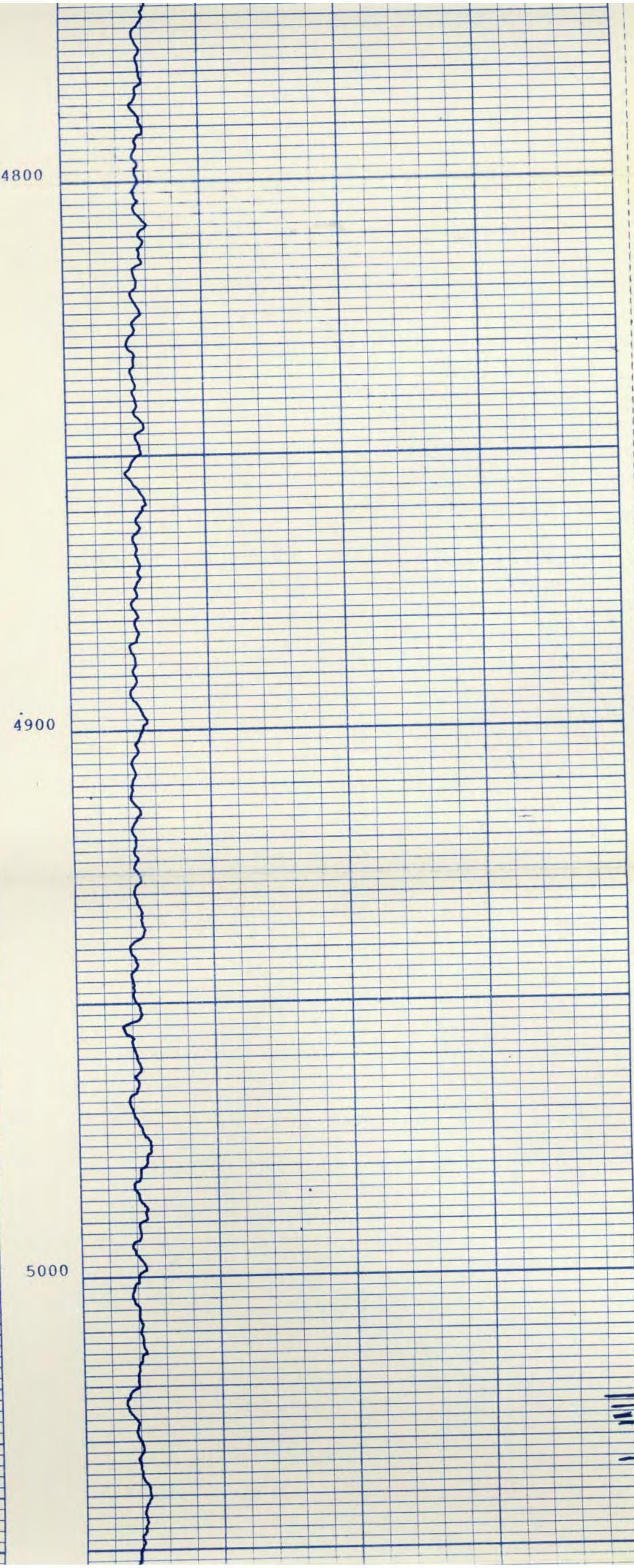
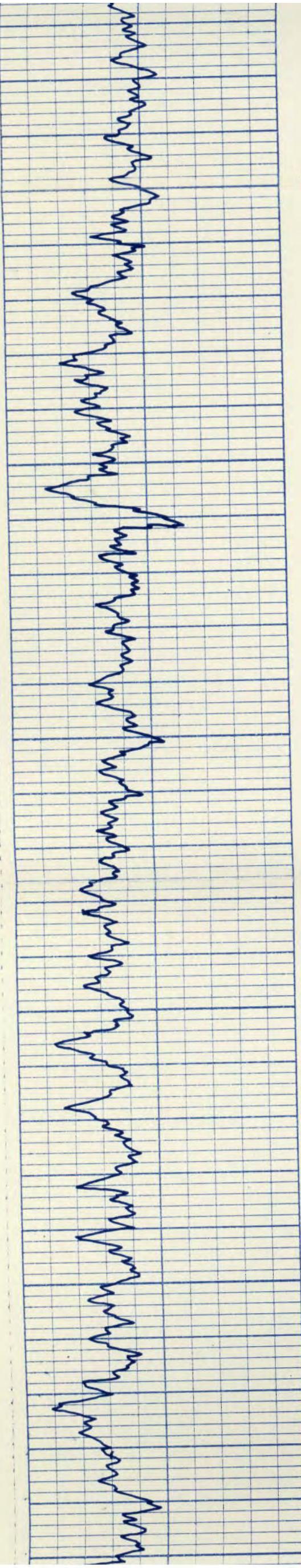
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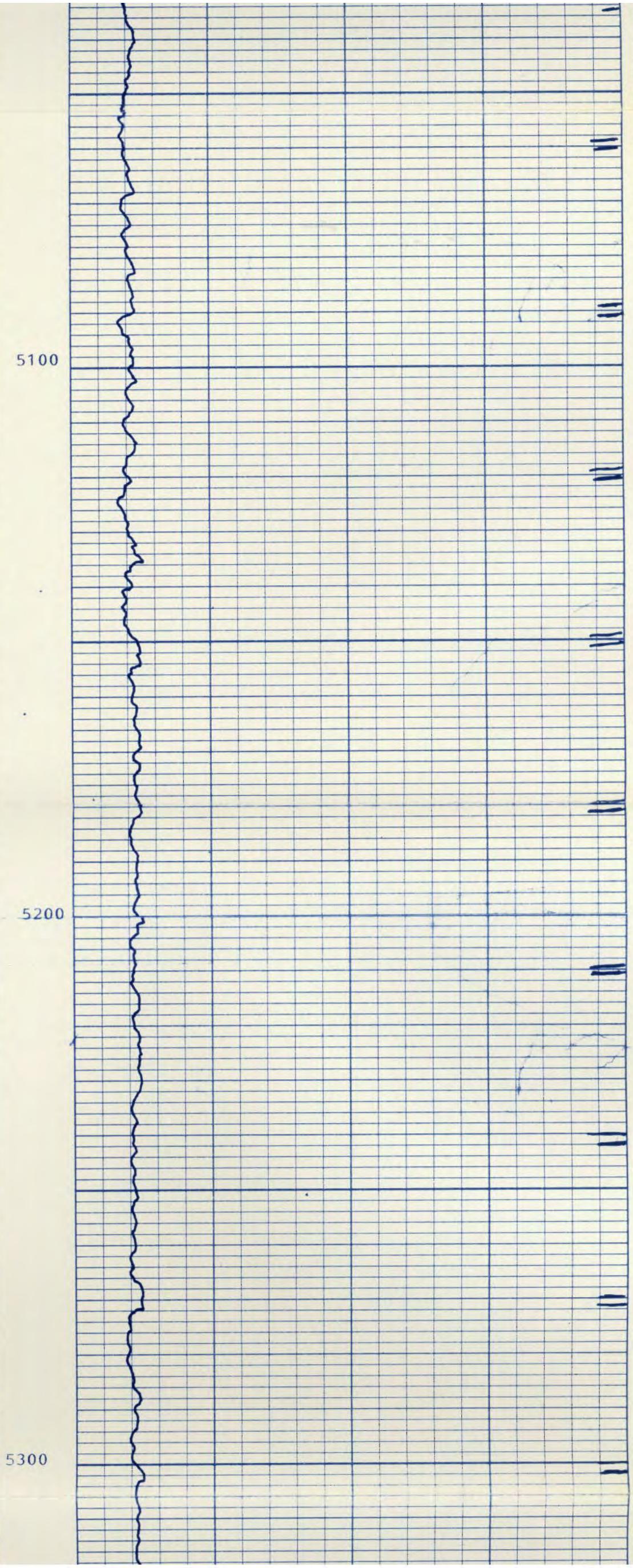
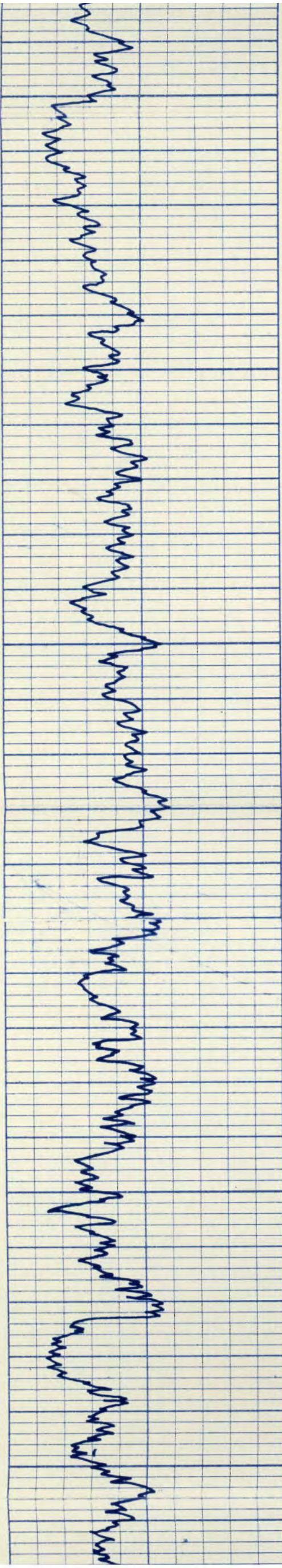
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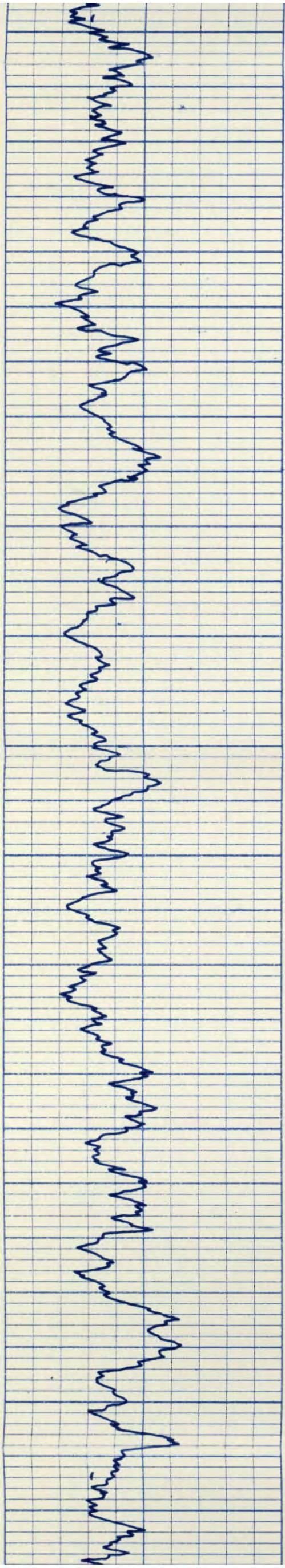








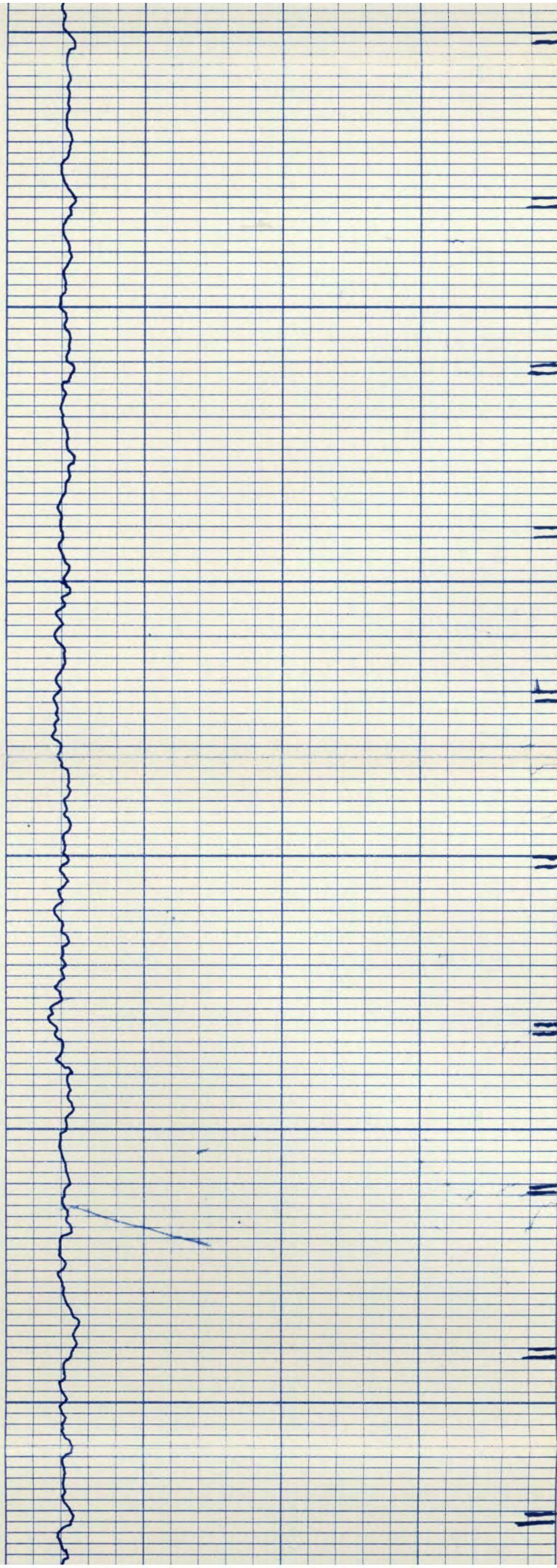


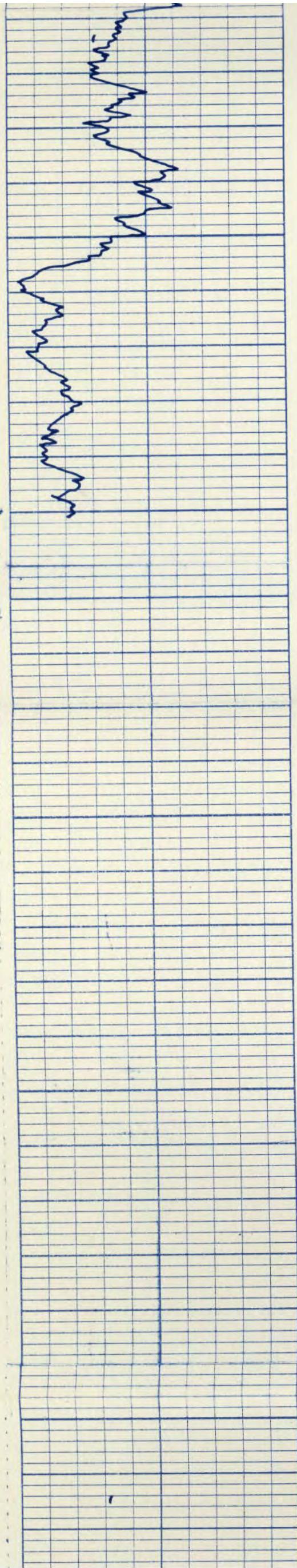


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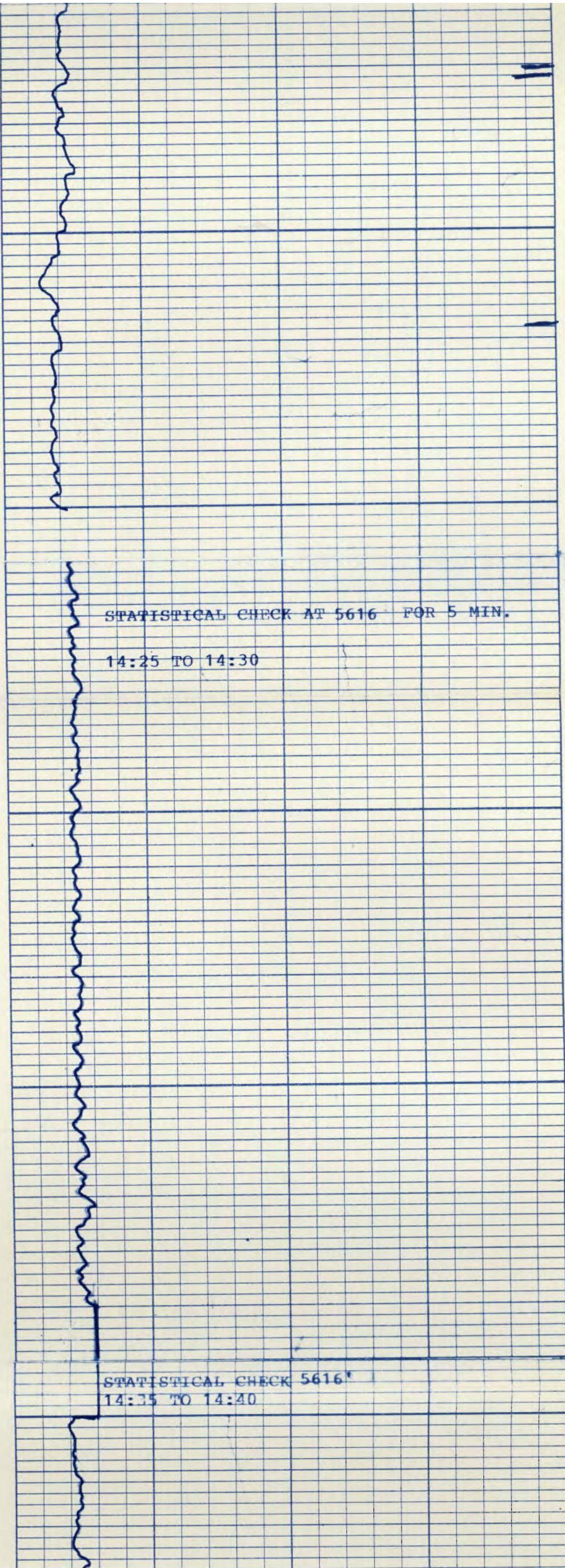
5400

5500





5600



STATISTICAL CHECK AT 5616 FOR 5 MIN.

14:25 TO 14:30

STATISTICAL CHECK 5616\*

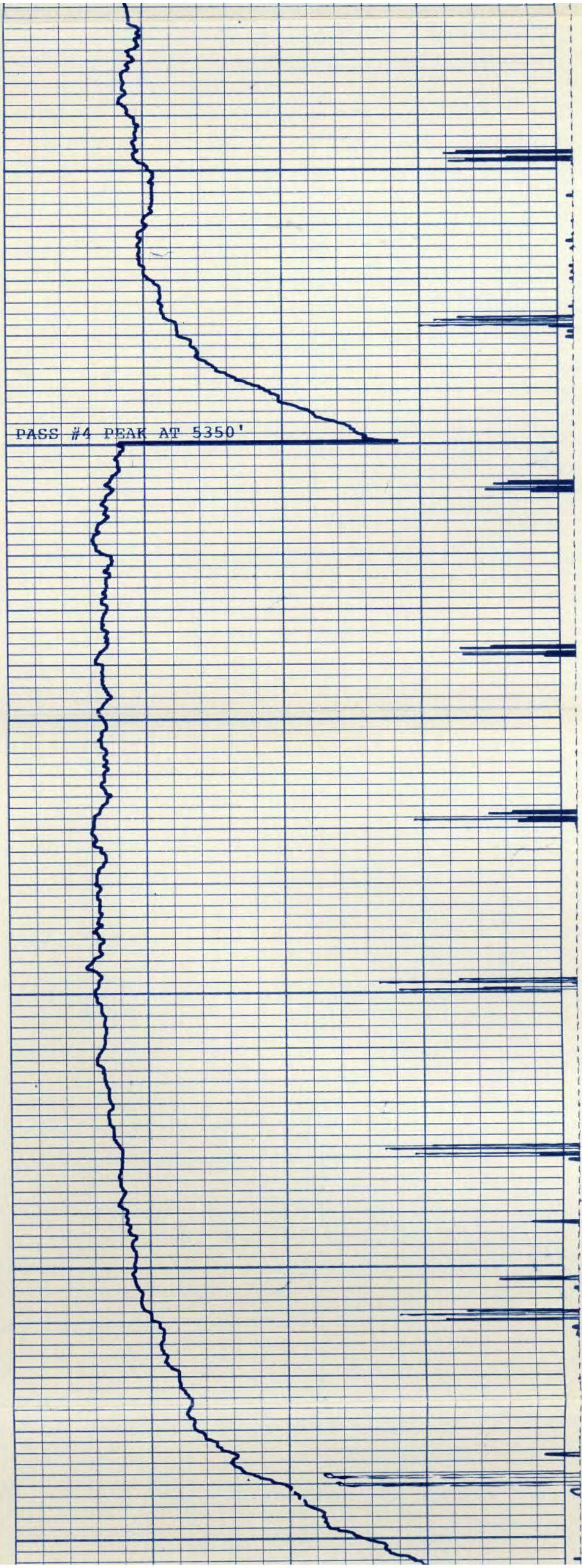
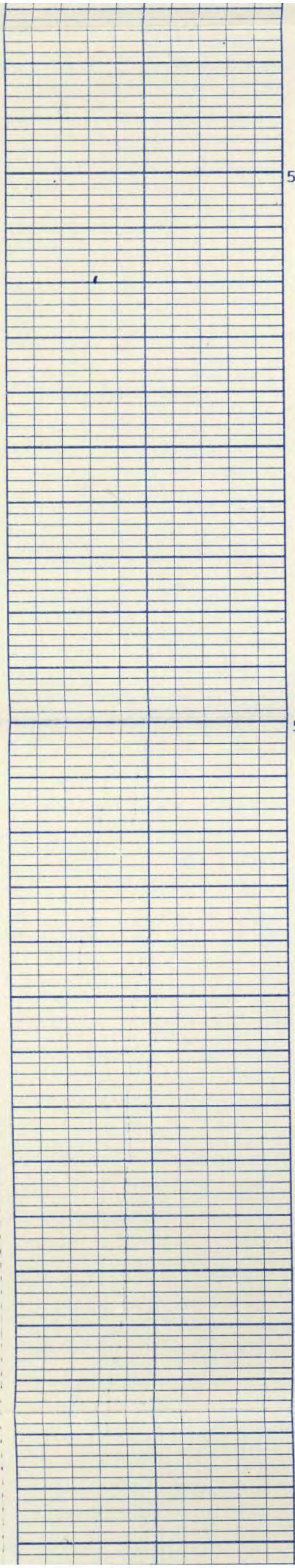
14:35 TO 14:40

4900

5000

INJECTED AT 1930 AT 15:15 50 GPM

PASS #1 PEAK AT 5030'



PASS #5 PEAK AT 5558'

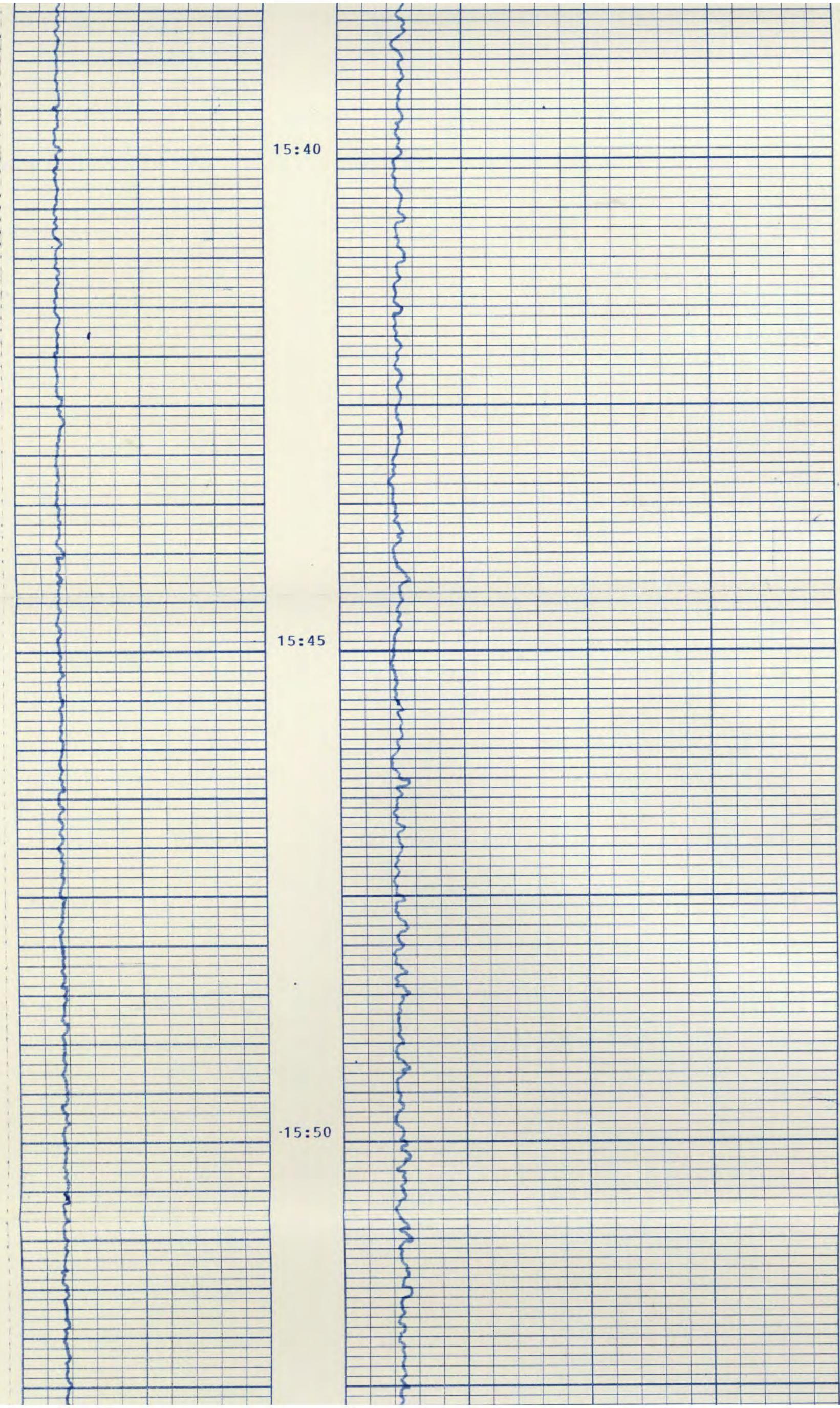
PASS #6 PEAK AT 5620'

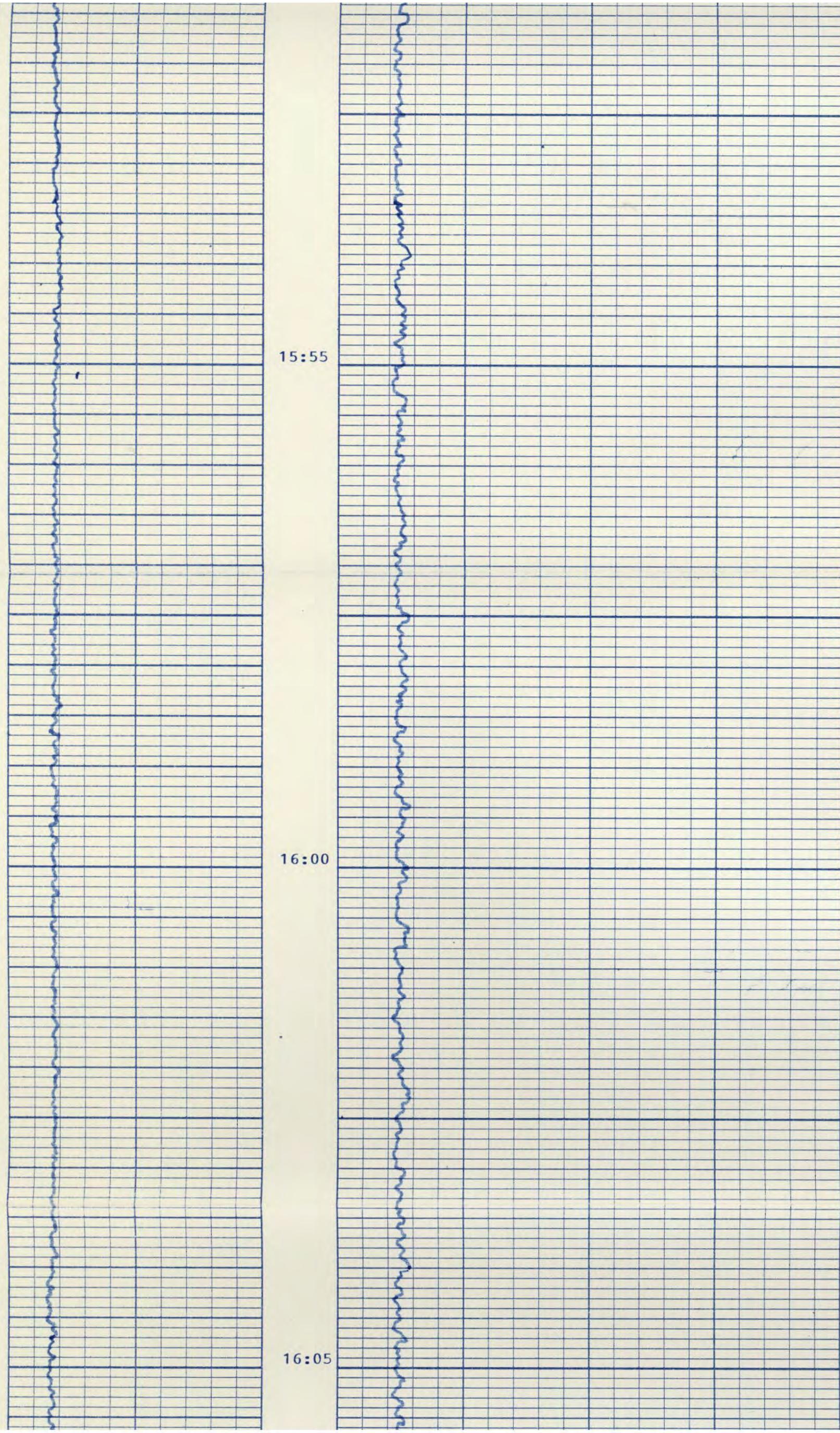
STATIONARY CHECK AT 5616'

INJECTED FOR 5 SEC. 10 MCI.

15:35

5600





16:05

0 API 80

API

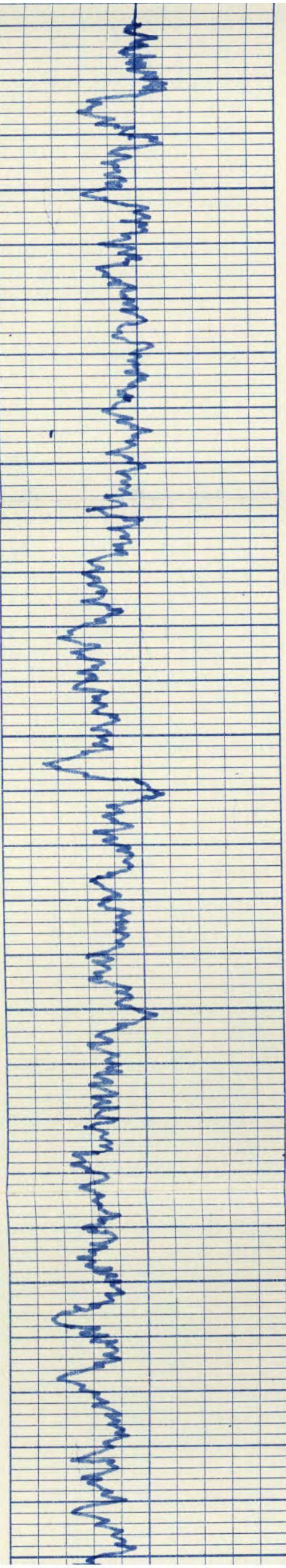
16:10

4700 0 API 400

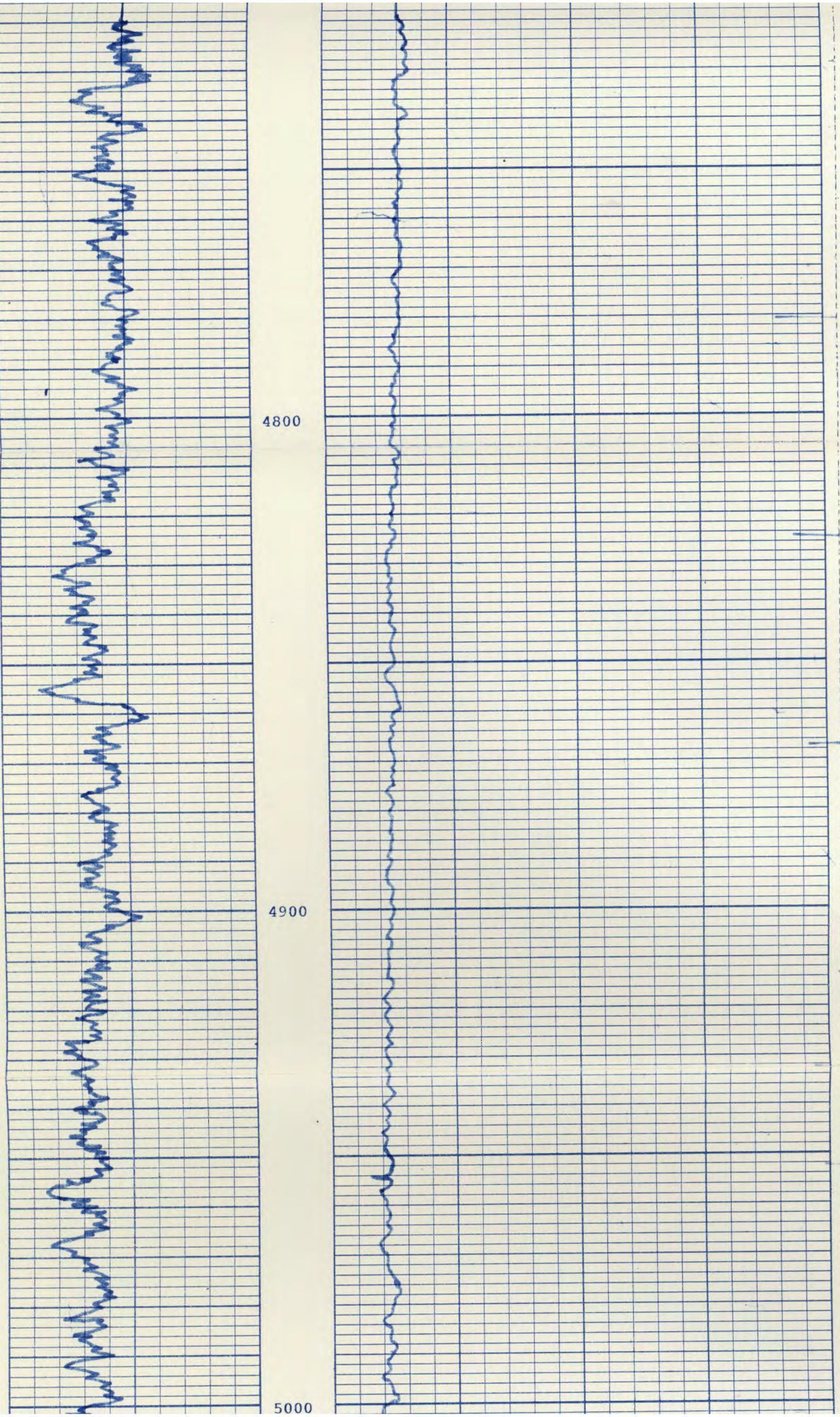
GAMMA RAY LOG AFTER SURVEY

API

16:15

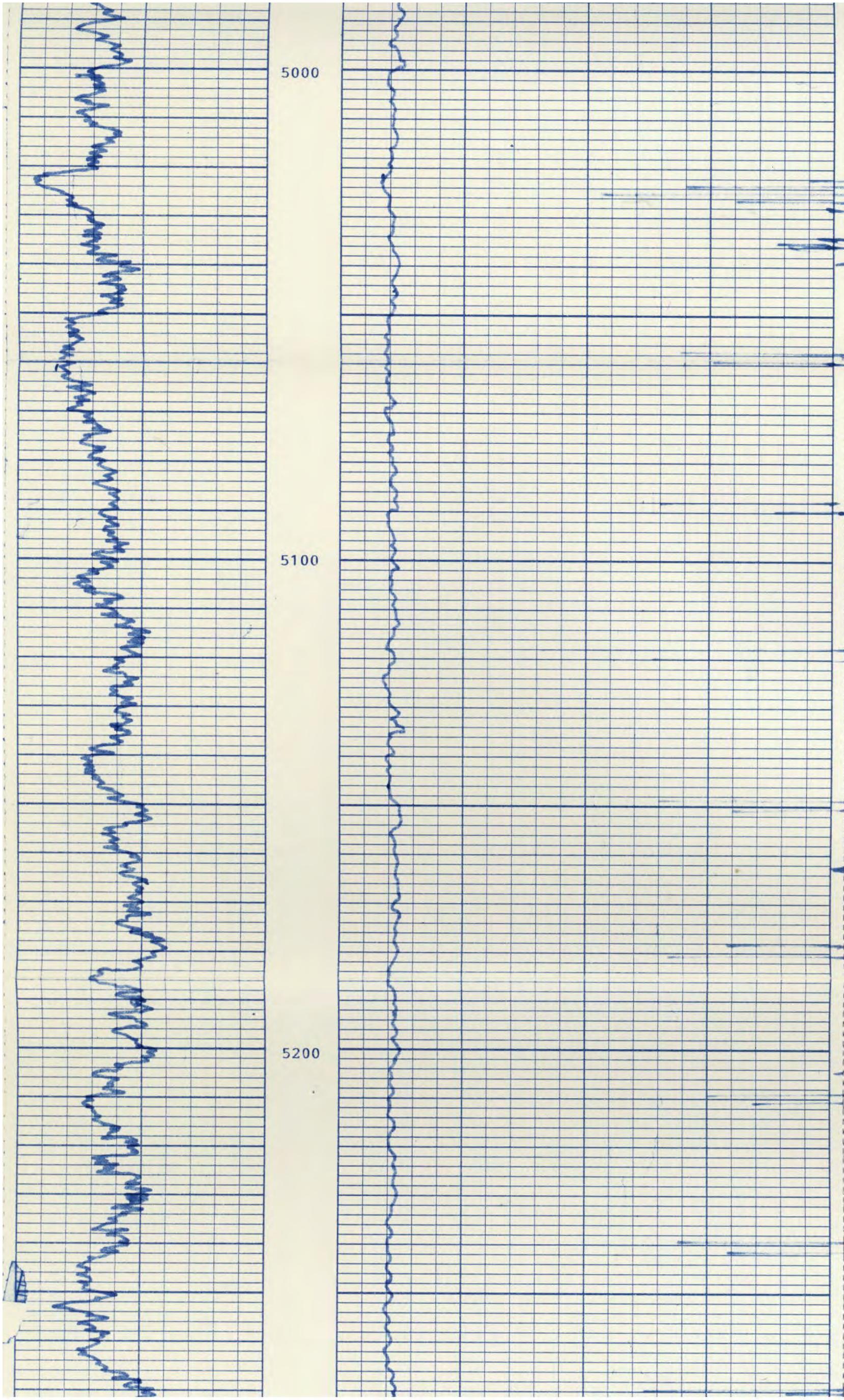


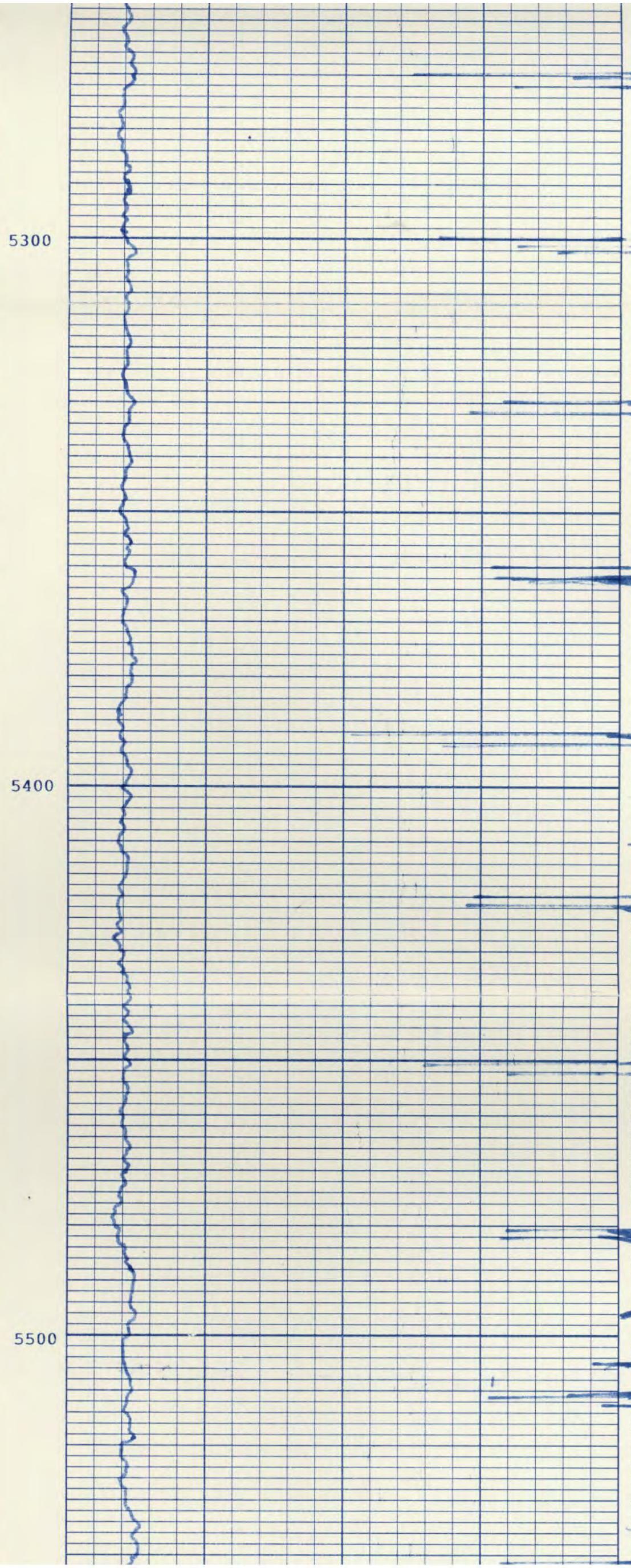
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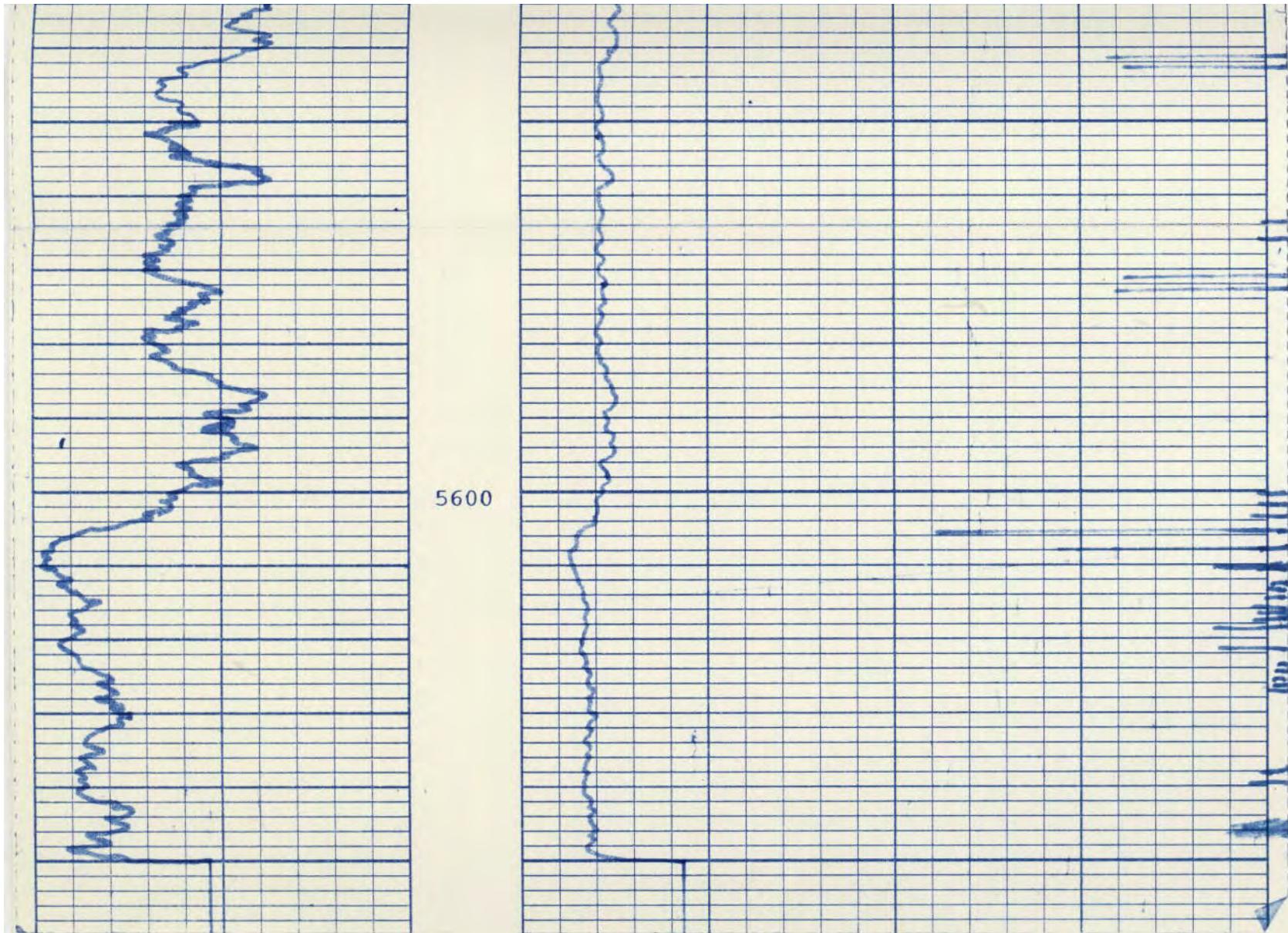


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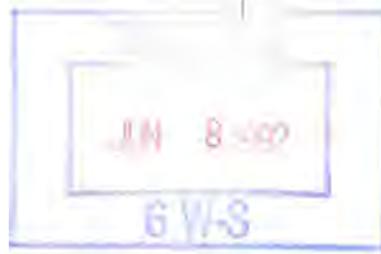
5000







June 1, 1992  
IOC-42-92

**Chemical Group**

Hoechst Celanese Corporation  
Bay City Plant  
PO Box 509  
Highway 3057  
Bay City, TX 77404-0509  
409 245 4871

Mr. Phillip B. Dellinger (6W-SU)  
Water Supply Branch  
Underground Injection Control Section  
Environmental Protection Agency  
Region VI  
1445 Ross Avenue  
Dallas, Texas 77202-2733

**Subject:** Request For Nonsubstantive Revision To Existing No-Migration Injection Well Petition  
Hoechst Celanese Chemical Group, Inc. Bay City Plant, Bay City, Texas (Reference Documents, EPA Fact Sheet Dated March 4, 1990, a Letter from Mr. Myron O. Knudson, EPA, Dated May 4, 1990, and a Letter from Mr. Kenton Kirkpatrick, EPA, Dated October 3, 1991, Included as Enclosures A, B and C Respectively)

Dear Mr. Dellinger:

As we have discussed: (1) the Hoechst Celanese Chemical Group, Inc., Bay City Plant original no-migration injection well petition and (2) the subsequent petition reissuance request document were intended to allow injection of the "acid" waste stream into the upper Miocene sands in WDW-110, Plant Well 1-A, and the proposed well, WDW-277 (if drilled). Unfortunately, injection into the upper Miocene by these two wells was not specifically allowed in the final petition, or the subsequent petition re-issuance approval.

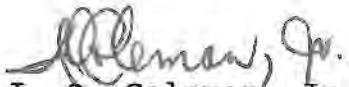
Due to injectivity problems associated with WDW-110, this has become an important issue. Therefore, we are requesting a re-evaluation of the petition approval restrictions. Specifically, we are requesting a nonsubstantive revision [per 40 CFR 148.20 (a)(1)(i)] of our approved no-migration petition to allow the completion and/or recompletion of WDW-110 (and WDW-277 if drilled) into the upper Miocene injection interval. This request is based on information submitted in the approved demonstration petition allowing injection by WDW-110 (and WDW-277 if drilled) into the upper Miocene sands.

Addendum I, attached, provides the rationale why we believe a nonsubstantive revision is appropriate. Furthermore, Addendum II attached, contain highlighted excerpts from the petition for your quick reference supporting our belief why the same is appropriate.

Your consideration and approval of our request for a nonsubstantive revision to our petition is appreciated.

Please don't hesitate to contact me by telephone at (409) 241-4197 if you have any comments or questions concerning this request or the information submitted herewith.

Very truly yours,



I. O. Coleman, Jr.  
Environmental Section Leader

IOC/la

Attachments

cc: Mr. Myron O. Knudson, P.E.  
Director  
Water Management Division (6W-5)  
U.S. Environmental Protection Agency  
Region VI  
1445 Ross Avenue  
Dallas, Texas 75202-2733

Mr. Richard Merritt  
Geologist  
Underground Injection Control Section  
Hazardous And Solid Waste Division  
Texas Water Commission  
P. O. Box 13087, Capitol Station  
1700 Congress Avenue  
Austin, TX 78711-3087

Mr. Oscar Cabra, Jr. Chief  
Water Supply Branch  
U. S. Environmental Protection Agency  
Region VI  
1445 Ross Avenue  
Dallas, Texas 75202-2733

Mr. Minor Brooks Hibbs, Chief  
Permit Section  
Hazardous And Solid Waste Divisions  
Texas Water Commission  
P. O. Box 13087, Capitol Station  
Austin, TX 78711-3087

bcc: C. R. Pennington - W/O Attachments  
H. P. Heathman  
B. L. Fritz - W/O Attachments  
N. C. Stafford - "  
G. E. Organ - "  
K. Williams - "  
G. J. McCarthy - "  
C. J. Schaefer - Dallas  
G. M. Rowen - Bridgewater  
Environmental File - 206.14  
R. Kinnon Golemon - File Copy Only - Austin

**ADDENDUM I**  
**RATIONALE FOR NON-SUBSTANTIVE REVISION TO APPROVED**  
**NO-MIGRATION PETITION**

**Introduction**

Due to well injectivity problems, we request a nonsubstantive revision (per 40 CFR 148.20) of our approved no-migration injection well petition to allow recompletion of WDW-110 (Well 1-A) and WDW-277, if drilled, into the upper Miocene injection interval. The upper Miocene is the current injection interval for WDW-14, 32, and 49 (i.e., the plant "neutral" waste injection wells Nos. - 2, 3, & 4). WDW-110, prior to injectivity problems injected an "acid" waste stream into the lower Miocene injection interval. Because of the injectivity problems with WDW-110, this acid waste stream is being neutralized and injected into the upper Miocene via existing Well, WDW-14.

WDW-277 is: (1) a proposed replacement injection well that has been included in the petition and (2) permitted by Texas Water Commission. This well may be drilled to augment injection well capacity and to replace WDW-110.

We are filing for this nonsubstantive revision to the no-migration petition per 40 CFR 148.20 and EPA Guidance Document #74. Guidance Document #74 provides a definition of a nonsubstantive petition revision. It states, "Nonsubstantive revisions are changes which do not affect the actual no-migration demonstration, but relate to matters addressed in the petition." This document provides examples of nonsubstantive revisions, one of which is "Well perforation location change in an injection interval already modeled in the approved petition." Bottom line, what we are requesting is to make a well completion interval change from one approved injection interval to another approved injection interval. This provision applies because the maximum flow rates (750 gpm) approved for the upper Miocene were modeled in the petition (with flow split between the "neutral" wells).

WDW-110 began experiencing injectivity problems during completion of the yearly MIT testing and will not currently accept injectate efficiently. Further testing revealed that the entire screened injection interval was blocked, thus preventing injection. After an engineering assessment was performed by our consultant, Golden Strata-Services, Inc., a decision was made to plug and abandon the current injection interval. We would therefore like to have the option to recomplete WDW-110 (and WDW-277, if drilled) into the upper Miocene interval.

The petition "Fact Sheet", which was issued by EPA Region VI on March 4, 1990, prior to the Public Hearing, did not specifically restrict injection into the upper Miocene by WDW-110 (and WDW-277, if drilled). The May 4, 1990 "Fact Sheet", issued by EPA Region VI at the point of final petition approval (following the Public Hearing), was the first time that WDW-110 (and WDW-277, if drilled)

#### ADDENDUM I (CONT'D)

was specifically restricted to injecting into the lower Miocene injection interval only. Because of the timing, we were prevented from objecting to this unnecessary restriction prior to final petition approval. We therefore request a revision to the petition to allow WDW-110 (and WDW-277, if drilled) to inject into the upper Miocene sands based upon information submitted in our approved no-migration petition.

#### PETITION CITATIONS

##### Petition Section 8

Permit No. WDW-110, allows the use of the upper Miocene sand as an injection interval for WDW-110. It states, "If any portion of the interval between 3300 and 3700 feet is used for injection, then the injection shall become coordinated with wells WDW-14, WDW-32, and WDW-49 in a manner such that the cumulative rate shall not exceed an average of 750 gallons per minute". A copy of the WDW-110 permit can be found in Section 8 of our petition and demonstrates our intent to use the upper Miocene sands for injection via WDW-110.

##### Petition Section 1

In the description of the injection interval for WDW-110 (Petition Section 1.6.2, pages 1-26, 27 and 28), it states that the permitted injection interval is between 2,900 and 5,900 feet which includes both the upper and lower Miocene sands. It goes on to state that, "If any portion of the interval between 2,900 and 3,700 feet be used for injection, then the injection shall be coordinated with Wells, WDW-14, 32 and 49 in a manner such that the cumulative rate shall not exceed an average of 750 gallons per minute [1].". These statements indicate that the injection into the upper Miocene be allowed for WDW-110 (and WDW-277, if drilled).

In the well data section of the petition, Section 1-3, we included the waste normally injected into WDW-110 in the description of the waste stream for WDW-14, 32 and 49. It states, "Wastes normally injected into WDW-110, when it is out of service for workover, provided that the pH of the injected fluids is adjusted to be no less than 5.0" This statement is: (1) located under the neutral waste stream description for WDW-14 (Petition Section 1.3.2. pages 1-16; (2) cited under the waste descriptions for WDW-32 (Petition Section 1.4.2, pages 1-20); and (3) also cited under the waste description for WDW-49 (Petition Section 1.5.2, pages 1-23). In the regulatory classification section of the petition Section 1-1, pages 1-6, 1-7 and 1-7b) it states: "During a workover or shutdown of WDW-110, the "neutral" well system can be used to dispose of the "acid" waste stream, after the "acid" waste has been properly neutralized to within the pH limits for the neutral well operation." The discussion further states; "Thus, the "neutral" well system consisting of WDW-14, 32, and 49 is being petitioned to allow injection of hazardous wastes, as well as the "acid" waste stream, during a shutdown of WDW-110."

ADDENDUM I (CONT'D)

These statements indicate the intent of the petition, i.e., to allow injection of the acid waste stream into the upper Miocene interval. (Maximum injection volumes were modeled for this sand assuming injection of both acid and neutral waste.) In the summary statement of the regulatory section of the petition (Section 1-1, page 108) it states, "The neutral wells are being included in the petition demonstration to maintain the flexibility of their use for the injection of this waste ("acid") due to any well problems in WDW-110 and due to potentially hazardous constituents present in the "neutral waste."

Petition Section 2

The preceding information demonstrates our intent to have the ability to inject into the upper Miocene interval via WDW-110. In the petition modeling section, WDW-110 (and WDW-277, if drilled) was not specifically modeled as injecting in the upper Miocene sand. Since our petition was one of the earlier ones submitted, it was believed that modeling maximum flow volumes for a sand was adequate for the demonstration regardless of which well emplaced the fluid. The upper Miocene sand was modeled at the maximum injection rate of 750 gallons per minute and the combined injection from all four wells will not exceed the value. Thus, the use of WDW-110 and/or WDW-277 (if drilled) injecting into the upper Miocene is in keeping with the modeling contained in the petition as long as the combined rate is less than 750 gallons per minute.

The diffusion aspect of the 10,000 year modeling for Bay City Plant utilized components of the "acid" waste stream which were assumed to be injected into the upper Miocene sand. In Appendix 2-11 of the Petition (page 5), it states, "In order to analyze diffusion conservatively, the assumption was made that WDW-110 is out of service and injection of the acid waste takes place into the upper Miocene sand. The upper Miocene injection sand is over 2,000 feet closer to the top of the injection zone than the lower Miocene injection sand....The analysis of this conservative case demonstrates that the chlorinated aldehydes in hazardous concentrations will be contained within the injection zone for at least 10,000 years". It can be concluded that injection of waste from WDW-110 (and WDW-277, if drilled) into the upper Miocene sand will not impact the 10,000 year modeling for diffusion.

Remodeling To Confirm Upper Miocene Interval Petition  
Demonstration For WDW-110 and 277

In the petition, the worst case scenario for the size of the 2000 year plume and the pressure build-up in the upper Miocene interval involved modeling using the maximum permitted injection volume (by Wells, WDW-14, 32, and 49). In order to assure that the most conservative pressure build-up and plume size had been presented in

## ADDENDUM I (CONT'D)

the petition, the model was re-run using the same maximum injection volume, and the flow was evenly distributed between Wells, WDW-110, 14, 32, and 49. The results from this model run showed that the size of the plume did not change, but merely shifted slightly to the north. The pressure build-up difference was only a few psi, that is, slightly higher with four wells injecting into the upper Miocene instead of three wells. These differences are insignificant given all the conservative factors and assumptions built into the petition demonstrations. Copies of both the original petition upper Miocene plume and pressure plots and the revised upper Miocene plume and pressure plots are attached as Addendum III, IV, V, and VI respectively.

In an effort to ensure that injection by all the wells into the upper Miocene sands did not change the 10,000 year plume location, the plume radius with maximum injection rates into three wells are compared to the plume radius with maximum injection rates into four wells. Since the 10,000 year modeling is based on the plume radius and the plume radius does not change, the 10,000 year modeling would not be affected by the injection of waste into the upper Miocene injection interval.

### Petition Reissuance Modeling

For the purpose of the petition reissuance to increase specific gravities, 10,000 year plume modeling runs were performed in the petition reissuance (Section 6) on both the upper and lower Miocene injection intervals using the highest and lowest specific gravity values (1.0 to 1.1 specific gravity). By using this method, the specific gravity range of the "acid" waste stream was included in the modeling of the upper Miocene sand. Therefore the injection of the "acid" waste stream by WDW-110 (and WDW-277, if drilled) into the upper Miocene will not change the results of previous modeling of the low density plume.

### Summary

It is therefore Hoechst Celanese Chemical Group, Inc., conclusion that a nonsubstantive revision of its no-migration petition can be granted which will allow the recompletion of WDW-110, or WDW-277 (if drilled), into the upper Miocene injection interval.

- C. Except as authorized by the Executive Director for purposes of performing a workover or shutting in the well, the density of injected fluids shall not exceed a specific gravity of 1.10.

VII. Injection Rates and Volumes

- A. The maximum rate of injection shall not exceed 800 gallons per minute.
- B. The average rate of injection shall not exceed 600 gallons per minute.
- C. The volume of wastewater injected shall not exceed 26,784,000 gallons per month. (Based on 600 gals/min. and a 31 day month)
- D. The volume of wastewater injected shall not exceed 315,360,000 gallons per year. (Based on 600 gals/min. and 365 days)
- E. If any portion of the interval between 3300 and 3700 feet is used for injection, then the injection shall become coordinated with wells WDW-14, WDW-32, and WDW-49 in a manner such that the cumulative rate shall not exceed an average of 750 gallons per minute.

VIII. Operating Parameters

- A. The operating surface injection pressure shall not exceed 900 psig.
- B. The tubing-long string casing annulus shall be filled with a corrosion inhibiting fluid. A positive pressure with a differential from injection pressure of at least 100 psi shall be maintained on the annulus to detect well malfunctions. Instrumentation shall be installed to detect well malfunctions by both annulus pressure changes and annulus volume changes.
- C. Pressure gauges shall be installed and maintained in proper operating conditions at all times on the injection tubing and tubing-long string casing annulus at the wellhead.
- D. Continuous recording devices shall be installed and maintained in proper operating conditions at all times to record injection tubing pressure, injection flow rate, injection volumes and tubing-long string casing annulus

## **1.6 WELL DATA - WDW-110**

### **1.6.1 Well Location - WDW-110**

Well Name/Number: WDW-110 (Well 1-A)

County: Matagorda

State: Texas

Well location (geographic coordinates):      Latitude:       $28^{\circ} 51' 48''$  North  
    Longitude:       $96^{\circ} 01' 15''$  West

Well location (legal description): Located on company property 18,050 feet from the east line and 2200 feet from the north line of the James Moore League, Abstract No. 62, Matagorda County, Texas [1].

Location to the nearest town (legal description):

Approximately 10 miles southwest of Bay City, Texas.

### **1.6.2 Injection Program - WDW 110**

Waste Stream Description:

#### "Acid" Waste Stream[1]

- o Wastes associated with the production of acetaldehyde, n-butyl alcohol, n-propyl alcohol, isobutyl alcohol and vinyl acetate.
- o Wastes generated during closure of the well and associated facilities that are compatible with permitted wastes and the reservoir.
- o The pH of the injected waste streams will not be less than 2.0. The density of the injected fluids will not exceed 1.10 under normal circumstances.

Well Completion Data:

Date Drilling Began:  
May 21, 1973

Drilling Completion Date:  
July 8, 1973

Original Permit: March 27, 1973  
(amended Nov. 5, 1973)

Current Permit: January 13, 1987

Date Began Injecting: August 17, 1973

Total Depth Drilled:  
5,935 feet (Original hole drilled depth)  
5,922 feet (Depth of sidetrack hole)  
5,921 feet (Depth of screen in sidetrack hole)

Well Status: Operating

Elevation:	Original Kelly Bushing (KB)	52.0 feet above SL
	Original ground level (GL)	35.0 feet above SL
	Original rig floor (RF)	51.0 feet above SL
	Original KB to GL	17.0 feet

Name and Depth of Injection Zone/Intervals:

- o Injecting into the "lower Miocene injection sand (interval)"
- o Injection Interval: 5,700 - 5,921 feet (measured depths on the well log)
- o Screened interval: 5,710-5,921 feet (top to bottom of slots in screened interval)
- o Permitted Injection Zone: "the approximate subsurface interval between 2,900 and 5,900 feet" [1].

ADDENDUM II (CONT'D)

Maximum injection rate permitted:

- o The maximum rate of injection will not exceed 800 gallons per minute [1].
- o The average rate of injection not exceed 600 gallons per minute [1].

Maximum Injection Volume:

- o The volume of wastewater injected will not exceed 26,784,000 gallons per month. (Based on 600 gallons per minute and a 31 day month) [1].
- o The volume of wastewater injected shall not exceed 315,360,000 gallons per year (Based on 600 gallons per minute and 365 days) [1].
- o If any portion of the interval between 2,900 and 3,700 feet is used for injection, then the injection shall become coordinated with Wells WDW-14, 32, and 49 in a manner such that the cumulative rate shall not exceed an average of 750 gallons per minute [1].

Maximum injection pressure (surface): 900 PSIG [1]

1-28  
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ADDENDUM II A  
Highfield Excerpts From No-Migration  
Petition  
(Section 1-3, Well Data)

### 1.3.2 Injection Program - WDW-14

Waste Stream Description:

#### Neutral Waste Stream [1]

- o Contaminated rainwater runoff associated with the production of Acetaldehyde, Vinyl Acetate, n-Butyl Alcohol, n-Propyl Alcohol, Iso- Butyl Alcohol, Heptanoic Acid, Nonanoic Acid, Hydrogen, Synthesis Gas, Heptanal and Nonanal.
- o Contaminated rainfall runoff, slab wash water, tank car heels, spillage and washwater from car-tank truck cleaning and loading areas.
- o Wastes normally injected into WDW-110, when it is out of service for workover, provided that the pH of the injected fluids is adjusted to be no less than 5.0.
- o Wastes generated during closure of the well and associated facilities that are compatible with permitted wastes and the reservoir.
- o The pH of the waste streams will not be less than 5.0. The density of the injected fluids will not exceed 1.10 under normal circumstances.

Well Completion Data:

Date Drilling Began:  
December 26, 1964

Drilling Completion Date:  
December 31, 1964

**1.4 WELL DATA - WDW-32**

**1.4.1 Well Location - WDW-32**

Well Name/Number: WDW-32 (Well 3)

County: Matagorda

State: Texas

Well location (geographic coordinates):      Latitude:  $28^{\circ} 51' 29''$  North  
    Longitude:  $96^{\circ} 01' 13''$  West

Well location (legal description):      Located 4,292 feet south and 2,029 feet west of the most northerly northwest corner of company property which is located on the James Moore League, Abstract No. 62, Matagorda County, Texas [1].

Location to the nearest town (legal description):

Approximately 10 miles southwest of Bay City, Texas.

**1.4.2 Injection Program - WDW-32**

Waste Stream Description:      WDW-32 injects the "neutral" waste stream. For a detailed description, see the Waste Stream Description for WDW-14.

Well Completion Data:

Date Drilling Began:

July 1967

Drilling Completion Date:

July 4, 1967

## **1.5 WELL DATA - WDW-49**

### **1.5.1 Well Location WDW-49**

Well Name/Number: WDW-49 (Well 4)

County: Matagorda

State: Texas

Well location (geographic coordinates):      Latitude:  $28^{\circ} 51' 24''$  North  
    Longitude:  $96^{\circ} 00' 59''$  West

Well location (legal description): The well is located 3,489 feet north and 2,442 feet east of the southwest corner of company property which is located on the James Moore League Abstract No. 62, Matagorda County, Texas.

Location to the nearest town (legal description): Approximately 10 miles southwest of Bay City, Texas.

### **1.5.2 Injection Program - WDW-49**

Waste Stream Description: WDW-49 injects the "neutral" waste stream. For a detailed description, see the Waste Stream Description under WDW-14.

Well Completion Data:

Date Drilling Began:  
May 7, 1969

Drilling Completion Date:  
May 11, 1969

ADDENDUM II-B  
Excerpts From No-Migration  
Petition  
(Section 1-1, Regulatory Classification)

### Acid Waste Stream (WDW-110 and Well 5)

The "acid" waste stream is generated from the manufacture of acetaldehyde, n-butyl alcohol, n-propyl alcohol, isobutyl alcohol and vinyl acetate. Currently, this "acid" waste is injected into the lower Miocene injection sand (interval) at 5700 feet using WDW-110. During a workover or shutdown of WDW-110, the "neutral" well system can also be used to dispose of the "acid" waste stream, after the "acid" waste has been properly neutralized to within the pH limits for the neutral well operation. When WDW-277 is in place and operational, it will serve as a backup for WDW-110.

The "acid" waste stream is composed principally of water containing small amounts of halogenated organic compounds (HOC's), ash, and trace quantities of metals. The HOC's derive from distillation side cuts (K010) and distillation bottoms (K009) from the production of acetaldehyde from ethylene. For a detailed description of the injected waste, see the Waste Stream Description for WDW-110 (1-A) in this Section (or see Section 7). Ammonia (NH<sub>3</sub>) or sodium hydroxide (NaOH) is used to adjust the pH. The typical pH of the injected "acid" waste stream is about 2.2, with a range of 2 to 3 (the pH is always controlled to be greater than 2.0).

Primarily, the "acid" waste is being banned from land disposal due to the K009 and K010 distillation products in the waste resulting from the production of acetaldehyde from ethylene. These "K-listed" wastes are contained in the second one-third of the "listed" wastes identified in 40 CFR 268.11. The K010 non-wastewater stream was banned from deepwell disposal after June 8, 1989, without an approved petition, and this stream is being recycled, and is not being currently injected, (although it may be in the future). The K009 wastewater stream was also banned from deepwell disposal on June 8, 1989, but a two year capacity variance was granted for this stream until June 8, 1991.

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The proposed "Third-Third" rule, published November 22, 1989, and the possible loss of the de-minimus exclusion, may also cause the "acid" stream to be banned on May 8, 1990 (or August 8, 1990) due to its low pH ( $\text{pH} < 2$  prior to treatment), due to possible U listed wastes, due to D001 ignitables, and the presence of hexavalent chromium. See the following table listing ban dates for the "acid" waste.

**Neutral Waste Stream (WDW-14, 32, and 49)**

The "neutral" waste stream is primarily contaminated rainwater and washwater generated from the manufacture of acetaldehyde, vinyl acetate, n-butyl alcohol, n-propyl alcohol, iso-butyl alcohol, heptanoic acid, nonanoic acid, hydrogen, synthesis gas, heptanal and nonanal. Currently, the "neutral" waste is injected into the upper Miocene injection (interval) sand at about 3,350 feet using Wells WDW-14, 32, and 49.

Normally, the waste stream consists principally of water containing small amounts of ash, oil and grease, and trace quantities of metals. In addition, contaminated rainwater runoff, and washwaters can at times be added to the waste stream and injected as part of the "neutral" waste (for a detailed description see the Waste Stream Description for WDW-14 in this Section or Section 7). Ammonia ( $\text{NH}_3$ ) or sodium hydroxide ( $\text{NaOH}$ ) is added to the waste stream to adjust the pH prior to injection, with the typical pH of the injected waste stream being about 6.2 with a range between 6.0 and 6.5.

Although the "neutral" waste is currently non-hazardous, the loss of the de-minimus exclusion or the final "third-third" regulations may make it hazardous. Thus, the "neutral" well system consisting of WDW-14, 32, and 49 is being petitioned to allow injection of hazardous wastes, as well as the "acid" waste stream, during a shutdown of

WDW-110. In an abundance of precaution, it is assumed that this waste stream, at the time of injection into the "neutral" well system, is impacted by the "acid" waste ban dates or is hazardous for some other reason. See the following table listing the specifics of possible ban dates for the neutral wells.

PAGE REVISED

**Summary**

In summary, various portions of the "acid" waste stream are banned (or may be banned) from continued injection on the following dates; June 8, 1989, May 8, 1990, August 8, 1990, and June 8, 1991, without an approved petition under 40 CFR 148 Subpart C. The neutral wells are being included in the petition demonstration to maintain the flexibility of their use for the injection of this waste due to any well problems in WDW-110 and due to potentially hazardous constituents present in the "neutral" waste. Thus, this petition is submitted for WDW-14, 32, 49, 110, and the proposed WDW-277, which may inject the "acid" waste stream, after the ban date.

The petition will show that the Hoechst Celanese Chemical Group, Inc., Bay City Plant well systems are 1) operating in an environmentally safe manner and 2) in compliance with the "no-migration" and non-endangerment standards. Approval of this petition by the Environmental Protection Agency (EPA), and/or by the Texas Water Commission (TWC), will allow continued injection operations of WDW-14, 32, 49, 110 and the proposed WDW-277 at the Bay City Plant.

Accordingly, the Hoechst Celanese Chemical Group, Inc., Bay City Plant hereby requests the EPA determine that continued injection operations under the conditions described in this petition will be protective of human health and the environment for as long as the waste remains hazardous, and publish notice of its determination in the Federal Register in accordance with RCRA subsection 3004(i), no later than May 8, 1990.

PAGE ONE OF EIGHT

ADDENDUM II-C  
Highlighted Excerpts From No-Migration  
Petition  
(APPENDIX 2-11)

In addition to the margins of safety identified above, the molecular diffusion model also implicitly contains other margins of safety. It discounts chemical effects such as adsorption and ion-exchange of contaminant species onto the walls of the aquiclude pore channels. Although sometimes difficult to quantify, these phenomena are known to retard the movement of contaminant ions and molecules through typical aquiclude lithologies, such as shales and clays (Freeze and Cherry, 1979 [1]). In addition, if an aquiclude layer is highly compacted, the diffusing ion or molecule may be too large to fit through the pore channels (Lerman, 1988 [2]; Deens, 1987 [7]). Finally, the presence of an electrical charge on the walls of the pore channels, as in the case of a shale or clay layer, will tend to prevent ionic (charged) species from even entering the rock matrix. This latter effect has been identified as the mechanism for the "osmosis" phenomenon (Freeze and Cherry, 1979 [1]).

## MODEL INPUT DATA AND SOURCES

### Site Specific Considerations

The diffusion calculations for the Bay City Plant are done for the chlorinated aldehyde components in the "acid" waste stream. These components are constituents of the "acid" waste stream which under normal circumstances is injected into the lower Miocene injection sand using WDW-110 (Well 1-A). If this well were to be shut down, the "acid" waste would be treated and neutralized, and injected into one or more of the three remaining "neutral" wells completed in the shallower horizon (upper Miocene injection sand).

In order to analyze diffusion conservatively, the assumption was made that WDW-110 is out of service and injection of the "acid" waste takes place in the upper Miocene injection sand. The upper Miocene injection sand is over 2,000 feet closer to the top of the injection zone than the lower Miocene injection sand. Thus the greater potential for movement out of the injection zone exists in the upper

Miocene injection sand. The analysis of this conservative case demonstrates that the chlorinated aldehydes in hazardous concentrations will be contained within the injection zone for at least 10,000 years as required by EPA 40 CFR 148.

#### Concentration Reduction Factor

The first step in the calculation of molecular diffusion is to calculate the concentration that the hazardous components must be reduced to in order to meet the health based limits. The concentration reduction factor is calculated by dividing the health-based limit (or detection limit) of the constituent, by the maximum concentration of the constituent in the waste stream. The dichloroacetaldehyde molecule is present in the highest concentrations (by 2x) of the three types of chlorinated aldehyde molecules present in the K009 and K010 wastes. The dichloroacetaldehyde molecule is also the hazardous constituent in the waste that is present in the greatest concentration, and also has the greatest concentration reduction factor. Thus a molecular diffusion distance was calculated for this molecule, since the other two aldehyde molecules will require a lower diffusion distance to reduce them to the detection limit (due to lower original concentrations).

No health-based limit is available for chloracetaldehydes so the detection limit of 1 ppm is used (see Petition Concerns Responses in last petition volume for source). The average concentration of dichloroacetaldehyde in the "acid" waste stream is 4100 ppm based on a waste stream analysis performed on November 22, 1988. For the purpose of worst case diffusion calculations a maximum concentration of 750,000 ppm is used. Based on a 750,000 ppm original concentration in the "acid" waste, and a 1 ppm detection limit, the concentration reduction factor for dichloroacetaldehyde in the Bay City Plant waste stream is  $1.33 \times 10^{-6}$ .

## 6.0 MODELING

The 10,000 Year plume modeling runs were performed on both the Upper and Lower Miocene Injection Intervals using the highest and lowest, specific gravity values. All parameters used in the initial petition demonstration have been held constant with the exception of the injectate waste stream specific gravity and the dip rate. A conservative dip rate of 50 feet per 1000 feet was used in the original petition, but a dip rate of 50 feet per mile is more representative of the actual regional gradient and therefore was used during remodeling in the reissuance. The resultant plumes are shown on the approved petition structure maps and are enclosed in Appendix D. The plume plots and modeling inputs are enclosed in Appendix C. The job and the output files are contained in Appendix G.

Four specific cases are presented in Appendix C: the Upper Miocene with a low density waste of 0.998 g/cc (at 113°F bottom hole temperature (BHT)), the Upper Miocene with a high density of 1.086 g/cc (at 113°F BHT), the Lower Miocene with a low density of 0.984 g/cc (at 137°F BHT), and the Lower Miocene with a high density of 1.080 g/cc (at 137°F BHT). The Upper and Lower Miocene low density cases have been reviewed on 5 to 10 year time increments ("snapshots") during the first 50 years of post-closure, since this is when the plume will move the maximum distance updip due to buoyancy.

Results of the Upper Miocene, 10,000 Year Plume Model show that low density plume (with an initial radius of 3500 feet) will move updip a maximum distance of 5,080 feet within 5 to 10 years after injection has ended. Snapshots of the plume are included in Appendix C for time periods of 5, 10, 15, 25, 50, 250, 500, 750, 1,000, 1,500, 2,000, 3,000, and 10,000 years after injection has ended. The maximum down dip distance of the Upper Miocene, low density plume after 10,000 years is approximately 34,000 feet. The Upper Miocene, high density, waste plume has a maximum down dip extent of approximately 44,600 feet in 10,000 years (as measured from the center of the plume).

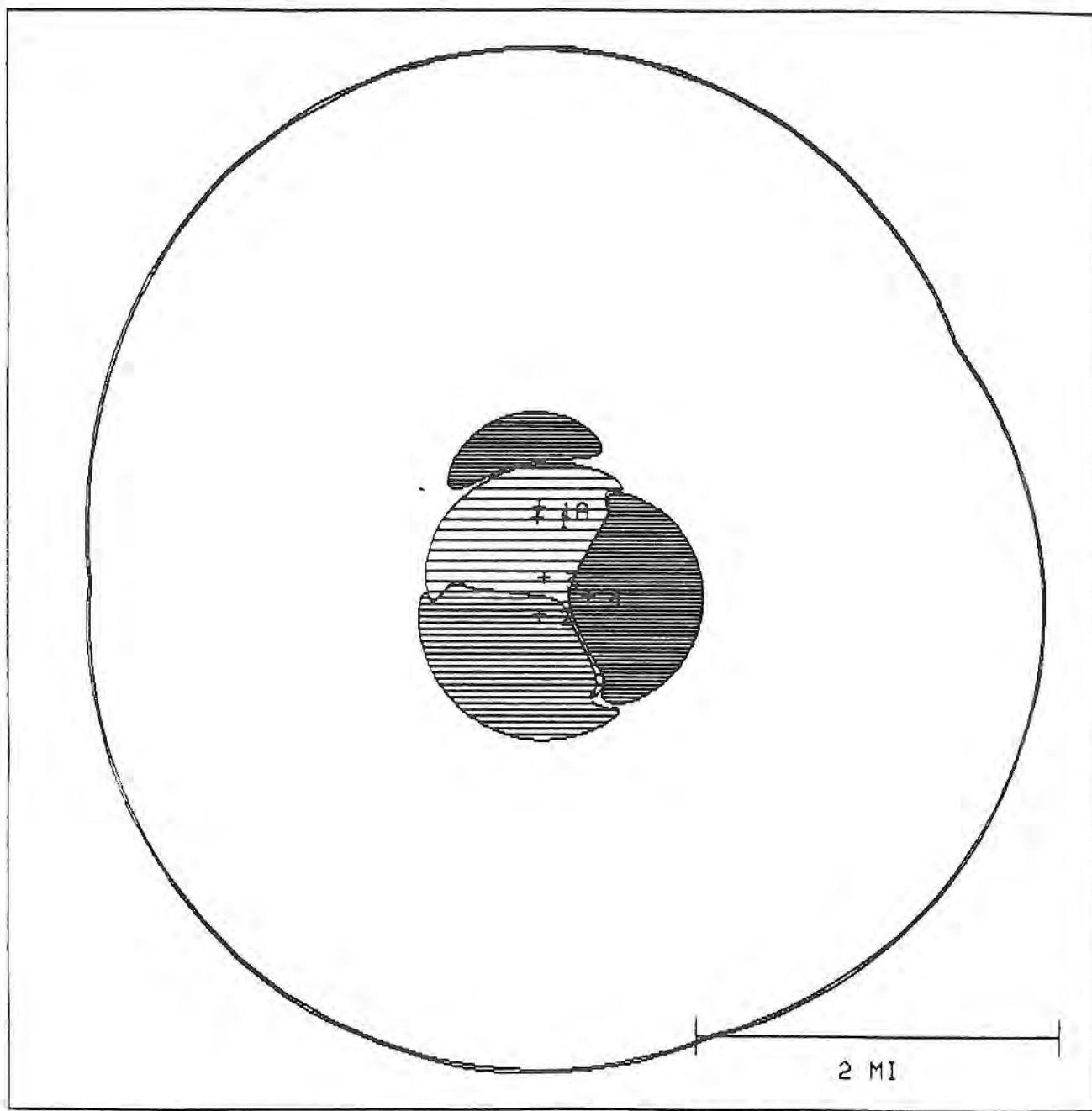
Results of the Lower Miocene, 10,000 Year Plume Model indicate that the low density plume (with an initial radius of 1950 feet) will move updip a maximum distance of 3,140 feet (during the first 10 years of post-closure). Snapshots of the plume are included in Appendix C for time periods of 10, 20, 30, 62.5, 125, 187.5, 250, 500, 1000, 1500, 2000, and 2500 years after injection has ended. The low density plume for 10,000 years has been hand calculated because of the Cray memory limitations. The model indicates that the plume moves 11,000 feet in 2500 years. The product of the natural groundwater flow velocity (3.18 ft/yr) and 7,500 years, yields a movement of 23,850 feet. The sum of the 2,500 year plume and the additional 7,500 year movement is 34,850 feet, which is the maximum distance traveled by the 10,000 year plume. A quick validation of this method is obtained by multiplying the natural gradient (3.18 ft/yr) by 2,500 years. This gives a value of 7,950 feet. Add this to the initial plume size (1,950 feet) and the hand calculation renders a downdip movement of 9,900 feet. This value is very similar to the more conservative 11,000 feet calculated by the model for the 2,500 time period. The high density, Lower Miocene, waste plume is modeled at approximately 38,000 feet downdip.

It should be noted that the original petition modeling for the plume size at the end of the operational life resulted in the following plume radii at the end of the year 2000:

<u>Injection Interval</u>	<u>Year 2000 Plume Radius</u>
Upper Miocene Sand	3500'
Lower Miocene Sand	1950

These radii do not include the multiplying factor which was used in the original Petition to account for any high permeability layers that may be present at the site. Given that the 10,000 year plume calculation accounts for dispersion, the operational life plumes without the multiplying factor were used as input into the 10,000 plume model. The above plume radii are given on P 2-76d in the original Petition. Also note that the operational plume plot diagrams in the petition are larger than the above radii because the plots include the effects of the multiplying factor.

ADDENDUM III  
(Original Petition Upper Miocene  
Plume)



- + 1 = WDW-8
- + 2 = WDW-14
- + 3 = WDW-32
- + 4 = WDW-49
- + IA = WDW-110

FIGURE 2-14  
COMPOSITE WASTE PLUME IN UPPER MIOCENE INJECTION SAND  
AT THE END OF 2000 USING MAXIMUM PERMITTED INJECTION RATES  
HOECHST CELANESE CHEMICAL GROUP, INC., BAY CITY PLANT

ADDENDUM IV  
(Or Final Petition Pressure Plots)

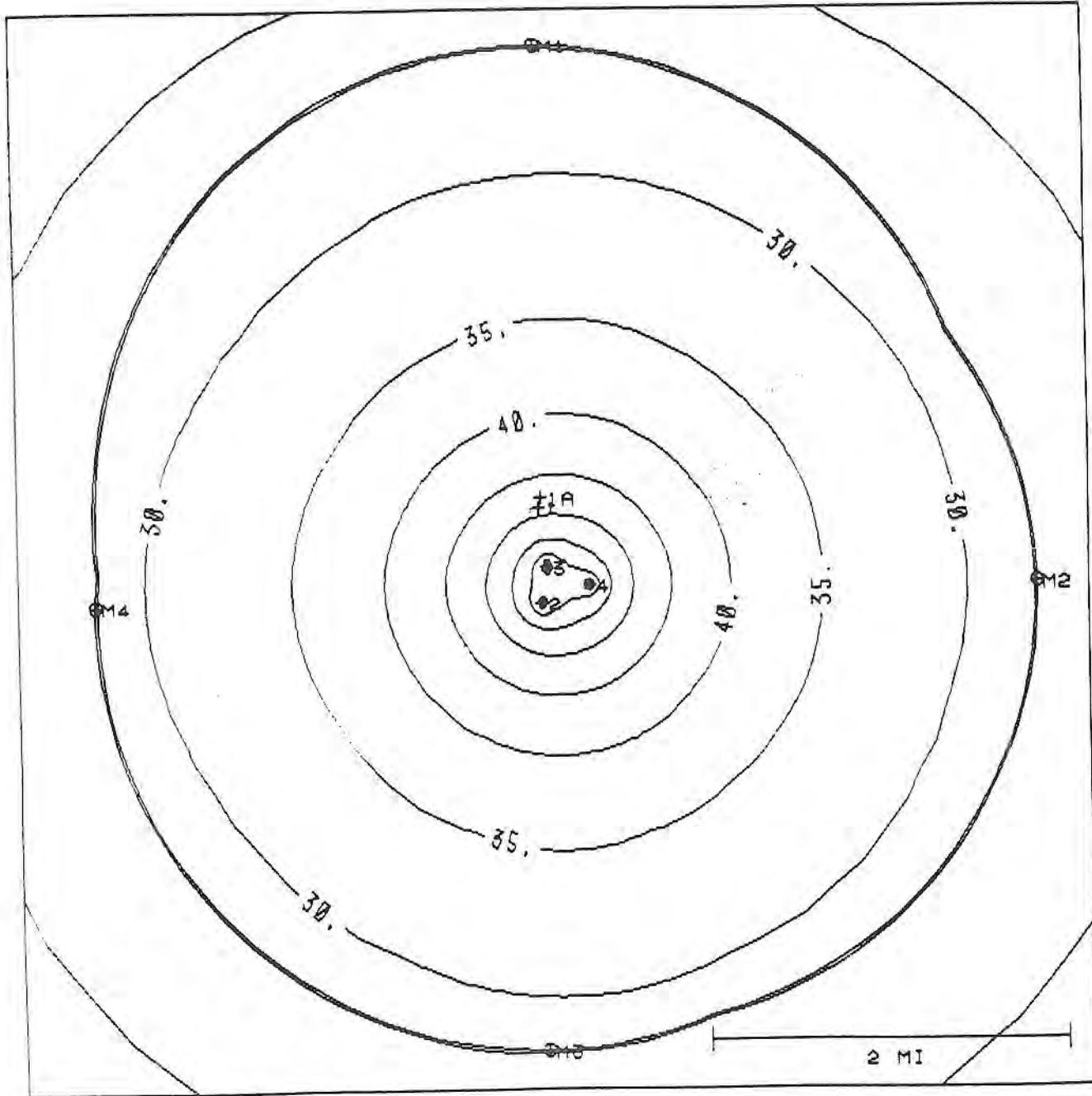
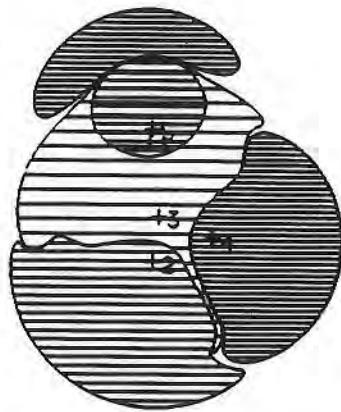


FIGURE 2-18  
PRESSURE CONTOUR PLOT IN UPPER MIocene INJECTION SAND  
AT THE END OF 2000 USING MAXIMUM PERMITTED INJECTION RATES  
HOECHST CELANESE CHEMICAL GROUP, INC., BAY CITY PLANT

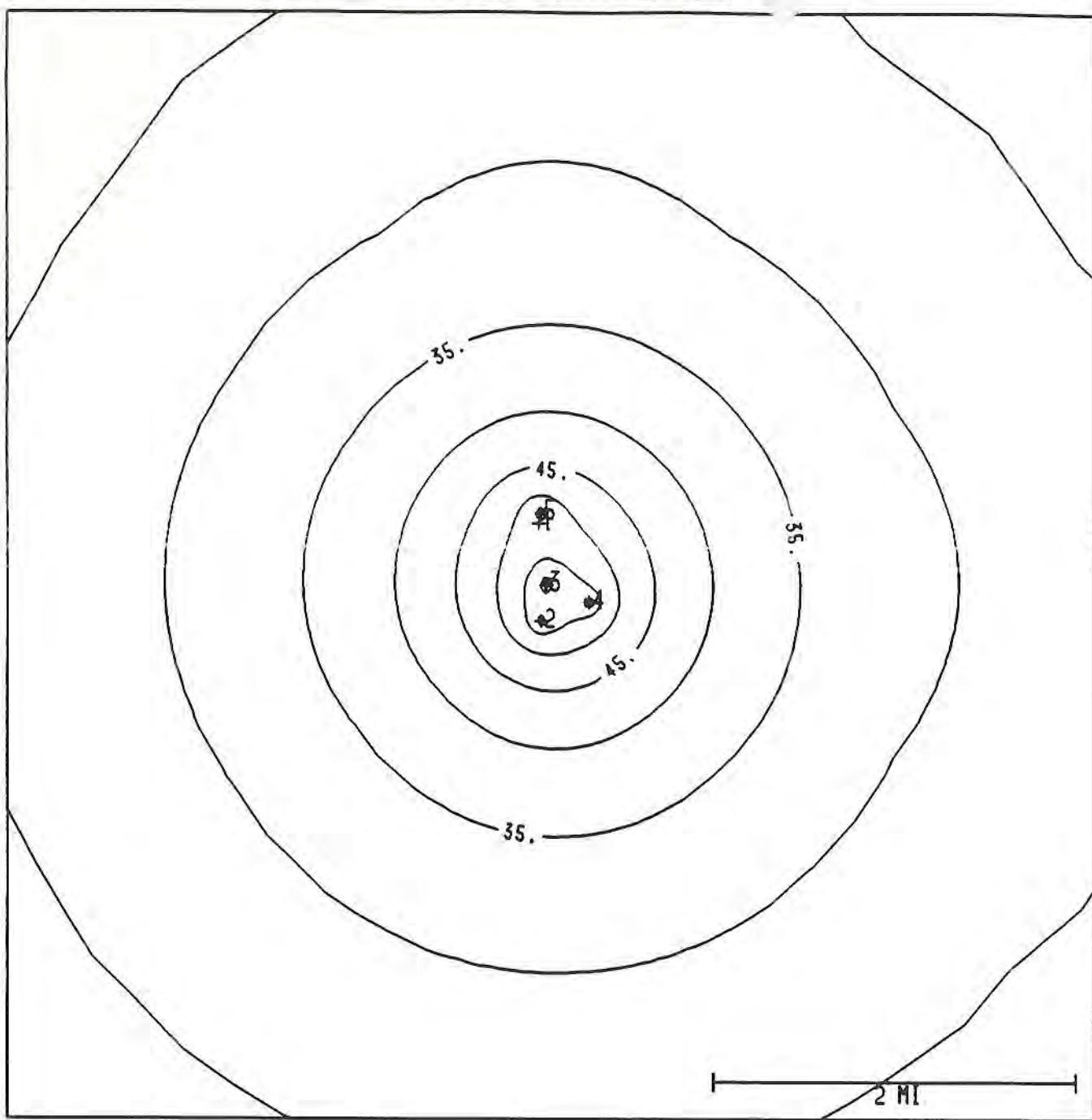


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2 MI

+1 = WDW-8  
+2 = WDW-14  
+3 = WDW-32  
+4 = WDW-49

**COMPOSITE WASTE PLUME IN UPPER MIocene INJECTION SAND AT  
THE END OF 2000 USING MAXIMUM PERMITTED INJECTION RATES  
INTO WDW-14, 32, 49, AND 110  
HOECHST CELANESE CHEMICAL GROUP, INC., BAY CITY PLANT**

ADDENDUM VI  
(REvised PETITION PRESSURE PLOTS)



+1 = WDW-8  
+2 = WDW-14  
+3 = WDW-32  
+4 = WDW-49  
+1A = WDW-110  
CI = 5.0 psi

PRESSURE CONTOUR PLOT IN UPPER MIOCENE INJECTION SAND AT  
THE END OF 2000 USING MAXIMUM PERMITTED INJECTION RATES  
INTO WDW-14, 32, 49, AND 110  
HOECHST CELANESE CHEMICAL GROUP, INC., BAY CITY PLANT

ENCLOSURE A

March 4, 1990

FACT SHEET

For proposed approval to allow injection of restricted hazardous wastes into the following injection well(s):

Applicant: Hoechst Celanese Chemical Group, Inc.  
Bay City Plant  
Farm Road 3057  
P. O. Box 509  
Bay City, Texas 77414

Facility Location: Matagorda County

<u>Permit Number</u>	<u>Well Number</u>
WDW-14	2
WDW-32	3
WDW-49	4
WDW-110	1-A
WDW-277	5

Issuing Office: U.S. Environmental Protection Agency  
Region 6  
First Interstate Bank Tower  
1445 Ross Avenue  
Dallas, Texas 75202-2733

1. The Environmental Protection Agency (EPA) proposes to allow the injection of restricted hazardous wastes into the well(s) described above and in the petition demonstration document.
2. This fact sheet or similar statement of basis is required under Title 40 of the Code of Federal Regulations, §§ 124.7 and 124.8 (40 CFR §§ 124.7 and 124.8, as referenced by 40 CFR §§ 148.22 and 124.10).
3. The following is an explanation of the derivation of the proposed decision, which is categorized according to the criteria outlined in 40 CFR Part 148. [53 Fed. Reg., 28118, (1988)]

Summary

The EPA land disposal restrictions promulgated under § 3004 of the Resource Conservation and Recovery Act prohibit the injection of hazardous waste unless a petitioner demonstrates to the EPA that there will be no migration of hazardous constituents from the injection zone for as long as the waste remains hazardous. These no migration demonstrations include a description of the well operations, geologic siting, and waste stream characteristics. They also include modeling

strategies which incorporate all the above mentioned information and utilize mathematical equations to predict pressure build up and waste movement.

The Hoechst Celanese - Bay City petition described its well operation through a discussion of the well construction, well stimulations, injection pressures, and injection volumes. The site location and geologic conditions were presented through a discussion of the depositional environment, well logs, cross-sections, well tests, geologic maps, and well records. The characteristics of the injection wastestream were described and evaluated for compatibility with the injection and confining zones. Hoechst Celanese incorporated all this information into a modeling strategy which predicted the pressure build up and waste movement for the Bay City site. The waste plume, under worst conditions, was predicted to move laterally approximately 7.3 miles southeast in the upper interval and 6.6 miles southeast in the lower interval in 10,000 years. Vertical movement is approximately 128 feet. Both of these distances are within the injection zone.

In addition to the reasonably conservative data and assumptions in the no migration demonstration, the following factors augment the demonstration of no migration:

- (a) The petition over predicts pressure buildup and waste plume extent by modeling the injection rate at 750 gpm for the upper interval and 600 gpm for the lower interval which is more than the historic rate of 251 gpm for the upper interval and 190 gpm for the lower interval.
- (b) The petition over predicts the injected hazardous constituent concentration by assuming the constituent concentration is two orders of magnitude greater than the measured value.
- (c) The petition is reasonably conservative by not taking into account the degradation of the contaminant in the injection zone. Examples of degradation which were not considered are adsorption, oxidation, hydrolysis, temperature, and microbiological degradation.
- (d) In the evaluation of artificial penetrations, the petition does not take into account the natural occurrence of wellbore closure. This occurs within the Gulf Coast region due to the unconsolidated sediments.

Therefore, after a detailed and thorough review of the Bay City site petition, the EPA proposes that Hoechst Celanese

has demonstrated, to a reasonable degree of certainty, that there will be no migration of hazardous constituents from the injection zone for a time period of 10,000 years.

The factors considered in the formulation of this proposed petition decision are described below.

Artificial Penetrations

The area around the Class I hazardous waste well cited in the petition must be evaluated to ensure that the injection activity will not endanger Underground Sources of Drinking Water (USDW) by causing movement of fluids into improperly sealed, completed, or abandoned wells. The petition applicant submitted information on all wells penetrating the injection or confining zones within 2.5 miles of the injection wells.

- (a) Artificial penetrations within the 2.5 mile radius are plugged or constructed to prevent the endangerment to an USDW.
- (b) There are 32 wells within the area of review (AOR) which meet this standard.
- (c) The calculated cone of influence (COI) is less than 1230 feet.

In addition to the nonendangerment standard, some artificial penetrations must also meet the no-migration standard. These artificial penetrations are wells which penetrate the injection zone and are located within the area of the waste plume movement over 10,000 years.

- (a) The artificial penetrations which penetrate the injection zone and are located within the area of the waste plume movement over 10,000 years are plugged or constructed to prevent the migration of hazardous waste from the injection zone.
- (b) There are 13 wells within the area of the plume which meet the no-migration standard.
- (c) All wells met this standard through a demonstration that waste movement due to pressure and molecular diffusion in an artificial penetration will remain within the injection zone.

Mechanical Integrity Testing (MIT) Information

To assure that the wastes will reach the injection zone, a petitioner must submit the results of pressure and radioactive tracer tests according to §148.20 (a)(2)(iv). A well has mechanical integrity when there is no significant leak in the casing, tubing, or packer, and when there is no significant fluid movement into an USDW through vertical channels adjacent to the injection well bore. The petition demonstrates that the active wells have been tested and do satisfy the above criteria.

<u>Well No.</u>	<u>Date of Pressure Test</u>	<u>Date of Radioactive Tracer Survey</u>
WDW-14	10-26-89	10-26-89
WDW-32	10-24-89	10-24-89
WDW-49	10-25-89	10-25-89
WDW-110	10-31-89	10-31-89
WDW-277	Not Drilled	

Injection well WDW-277 must meet the requirements of the Texas Water Commission injection permit. Results of the pressure and radioactive tracer tests must be submitted to the EPA Region 6 for approval prior to injection of restricted hazardous waste in well WDW-277. In addition, information obtained from the drilling and construction of the WDW-277 well shall be submitted to the EPA Region 6 to ensure the basis for the petition decision continues to remain valid. The information should include well logs, geologic core analysis of the confining and injection zones, a hydrogeologic compatibility determination, and formation tests.

Quality Assurance

According to §148.21 (a)(4), the Hoechst Celanese - Bay City petition demonstrates that proper quality assurance and quality control plans were followed in preparing the petition demonstrations.

Specifically, Hoechst Celanese has followed appropriate protocol in identifying and locating records for artificial penetrations within the Area of Review. Information regarding the geology, waste characterization, hydrology, reservoir modeling, and well construction has also been adequately verified or bounded by worst-case scenarios.

Regional and Local Geology

Class I hazardous waste injection wells must be located in areas that are geologically suitable. The injection zone must have sufficient permeability, porosity, thickness, and

areal extent to prevent migration of fluids into USDW's. The confining zone must be laterally continuous and free of transmissive faults or fractures to prevent the movement of fluids into an USDW and must contain at least one formation capable of preventing vertical propagation of fractures. The Hoechst Celanese-Bay City facility is sited in an area meeting the above criteria.

An evaluation of the structural and stratigraphic geology of the local and regional area has determined that the Hoechst Celanese-Bay City facility is located at a geologically suitable site. The injection zone is of sufficient permeability, porosity, thickness, and areal extent to meet requirements stated in 40 CFR Part 148. The confining zone is laterally continuous and free of transecting, transmissive faults or fractures over an area sufficient to prevent the movement of fluids into a USDW.

(1) Depth of Confining Zone: 2350 feet  
Depth of Injection Zone: 2900 feet  
Depth of Injection Intervals: 3350-3600 feet  
5700-5950 feet

- (2) The geologic conditions were presented through a discussion of the depositional environment, well logs, cross-sections, well tests, and geologic maps.
- (3) The structure and isopach maps provided confidence in the geologic description.
- (4) The geologic cross-sections demonstrated that the injection zone is laterally continuous. This justified some of the modeling assumptions.
- (5) Pressure falloff tests support the injection zone permeability parameter in the modeling strategy.

#### Hydrogeology

According to §148.20 (a)(1), a petitioner must submit hydrogeologic information in order to study the effects of the injection well activity. Hoechst Celanese provided hydrogeologic information in the petition which demonstrates that USDW's are properly protected. The base of the lowermost USDW is at 1300 feet.

#### Characteristics of Injected Fluids

According to §148.22 (a), the characteristics of the injection wastestream must be adequately described in order to determine the wastestream's compatibility with the injection zone. These characteristics are described in the petition and the description is adequate and complete.

ENCLOSURE A (CONT'D)

6

The waste contain the following EPA hazardous waste numbers: K009, K010, D001, D002, U001, U002, U031, U112, U123, U140, U154, U197, U226, F001, F002, Hexavalent Chromium

Geochemistry and Injected Waste Compatibility

According to §148.21 (b) (5), a petitioner must describe the geochemical conditions of the well site. The physical and chemical characteristics of the injection zone and the formation fluids in the injection zone were described in the petition. This description included a discussion of the compatibility of the injected waste with the injection zone.

- (1) The geochemistry of the injection zone was described through the use of core data.
- (2) Hoechst Celanese provided evaluations which demonstrated that the waste stream would not adversely alter the confining capabilities of the injection and confining zones.

Modeling Strategy

According to 40 CFR §148.21(a)(3), in demonstrating no-migration of hazardous constituents from the injection zone, predictive models shall have been verified and validated, shall be appropriate for the specific site and wastestreams, and shall be calibrated for existing sites. The modeling strategy consisted of a combination of analytical models. All the models used were identified as being verified and validated according to the information submitted in the petition. This information consisted of actual model documentation or references of methods or techniques that are widely accepted by the technical community. The petition describes the predictive models used and demonstrates that the above criteria are met.

According to 40 CFR §148.21(a)(5), reasonably conservative values shall be used whenever values taken from the literature or estimated on the basis of known information are used instead of site-specific measurements. Many variables were required to be quantified in order to employ the models used in the petition. All parameters were conservatively assigned to produce worst case conditions for either pressure buildup or waste movement.

According to 40 CFR §148.21 (a)(6), a petitioner must perform a sensitivity analysis in order to determine the effect of uncertainties associated with model parameters. Hoechst Celanese provided this sensitivity analysis in its petition. Through conservative model parameter assignments within this analysis, worst case scenarios for pressure buildup and waste movement were investigated and reported.

Results

1. Operational Life

Estimated Operational Life: Year 2000  
Maximum Permitted Injection Rates:

WDW-14	Combined annual
WDW-32	average of 750 gpm
WDW-49	in upper interval
WDW-110	Combined annual
WDW-277	average of 600 gpm
	in lower interval

Maximum Pressure Buildup (at wells):

Upper interval	87 psi
Lower interval	86 psi

Maximum Lateral Waste Movement:

Upper interval	0.9 miles
Lower interval	0.8 miles

Maximum Vertical Waste Movement: <2.0 feet

2. 10,000 Year Post-Injection Period

Background Gradient or Velocity:

Upper interval	2.8 feet/year in southeast direction from site
Lower interval	3.2 feet/year in southeast direction from site.

Waste Density Effects Yes  N/A \_\_\_\_\_  
Movement Due to Hydrocarbon Production Yes \_\_\_\_\_ N/A

Maximum Waste Concentration Reduction Factor is  $10^{-6}$

Maximum Lateral Waste Movement:

Upper interval	7.3 miles in southeast direction from site
Lower interval	6.6 miles in southeast direction from site

Maximum Vertical Waste Movement is 128 feet in intact strata and 330 feet in mud.

ENCLOSURE B

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 6

1445 ROSS AVENUE SUITE 1500

DALLAS, TEXAS 75202-2720

May 4, 1990

**CERTIFIED MAIL P-105 324 969  
RETURN RECEIPT REQUESTED****REPLY TO: 6W-SU**

Mr. I. O. Coleman  
Environmental Affairs  
Hoechst Celanese Chemical  
Group, Incorporated  
P.O. Box 509  
Bay City, Texas 77414

Re: Final Hoechst Celanese Chemical Group, Incorporated - Bay City, Texas,  
Petition Decision

Dear Mr. Coleman:

Effective the date of this letter, the Environmental Protection Agency (EPA) approves the Hoechst Celanese - Bay City petition for an exemption to the land disposal restrictions imposed by the Hazardous and Solid Waste Amendments of 1984 to the Resource Conservation and Recovery Act. This approval is contingent upon the conditions listed below.

The land disposal restrictions prohibit the injection of hazardous waste unless a petitioner can demonstrate to the EPA, to a reasonable degree of certainty, that there will be no migration of hazardous constituents from the injection zone for as long as the wastes remain hazardous. The land disposal restrictions for injection wells which are codified in 40 CFR Part 146, provide the standards and procedures by which petitions to dispose of an otherwise prohibited waste by injection will be reviewed and by which exemptions pursuant to these petitions will be granted or denied.

A letter dated March 6, 1990, informed Hoechst Celanese that the Environmental Protection Agency (EPA) would propose to approve the Bay City petition for an exemption to the land disposal restriction. The public comment period associated with this proposed decision began on March 7, 1990, and closed on April 20, 1990. In addition to this comment period, a public hearing was held in Bay City, Texas, on April 12, 1990, to allow the local public the opportunity to present comments concerning the EPA's proposed decision. Enclosed is EPA's response to the issues raised during the public comment period.

( ENCLOSURE B CONT'D )

2

Based on a detailed technical review of the submitted petition and support documents, the information presented during the public comment period, and consultations with the Texas Water Commission, the EPA has determined that the Hoehst Celanese - Bay City, petition meets the requirements of 40 CFR Part 148 by demonstrating no migration of hazardous constituents from the injection zone for 10,000 years.

Petition Approval Conditions

The final approval to allow injection of restricted hazardous wastes is subject to the following conditions. Noncompliance with any of these conditions is grounds for termination of the exemption in accordance with 40 CFR 148.24(a)(1).

1. This exemption is only for the four injection wells WDW-14, WDW-32, WDW-49, and WDW-110 which were permitted by the Texas Water Commission.
2. Injection of restricted waste shall be limited to the injection intervals for the following wells:

Well No. WDW-14 3350 to 3600 feet. (log depth)  
Well No. WDW-32 3350 to 3600 feet. (log depth)  
Well No. WDW-49 3350 to 3600 feet. (log depth)  
Well No. WDW-110 6700 to 5950 feet. (log depth)

These injection intervals occur in an injection zone occurring at a depth of 2900 feet to 6200 feet (log depth).

3. The cumulative monthly volume injected in WDW-14, WDW-32, and WDW-49 shall not exceed 33,480,000 gallons. The monthly volume injected in WDW-110 shall not exceed 26,784,000 gallons.
4. The facility shall cease injection of restricted hazardous waste by December 31, 2000.
5. The characteristics of the injected waste stream shall at all times conform to those of Section 2.1 in the petition. The density of the waste stream shall remain within a range of from 1.0012 to 1.0034, inclusive.

The final approval for injection is limited to the following hazardous wastes: K009, K010, D001, D002, U001, U002, U031, U118, U123, U140, U154, U197, U226, F001, F002, Hexavalent Chromium.

ENCLOSURE B (CONT'D)

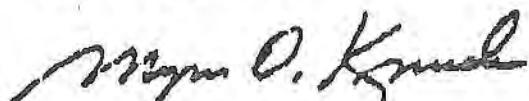
3

7. Hoechst Celanese must petition for approval to inject additional hazardous wastes which are not included in Condition No. 8, above. Hoechst Celanese must also petition for approval to increase the concentration of any waste which would necessitate the recalculation of the limiting concentration reduction factor and the extent of the waste plume. Petition modifications and reissuance should be made pursuant to 40 CFR 148.20 (e) or (f).
8. Hoechst Celanese shall annually submit to EPA the results of a bottom hole pressure survey for WDW-14, WDW-32, WDW-49, and WDW-110. This survey shall have been performed after shutting in each well for a period of time sufficient to allow the pressure in the injection interval to reach equilibrium, in accordance with 40 CFR 146.66(e)(1).
9. Upon the expiration, cancellation, reissuance, or modification of the Texas Water Commission's Underground Injection Control permit for Well No(s). WDW-14, WDW-32, WDW-49 and WDW-110, this exemption is subject to review. A new demonstration may be required if information shows that the basis of granting the exemption is no longer valid.

In addition to the above conditions, this final petition approval is contingent upon the validity of the information submitted in the Hoechst Celanese - Bay City petition for an exemption to the land disposal restrictions. This approval is subject to termination where new information shows that the basis for approval of the petition is no longer valid, which is in accordance with Section 148.24(a)(3).

If you have any questions or comments, please call Oscar Cabra, Jr., at (214) 655-7150.

Sincerely yours,



Myron O. Knudsen, P.E.  
Director  
Water Management Division (6W)

Enclosures

Michael Cook (WH-550A)  
Francoise Brasier (WH-550E)  
Texas Water Commission

ENCLOSURE CUNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
REGIONS  
1145 ROSS AVENUE, SUITE 1200  
DALLAS, TEXAS 75202-2703

October 3, 1991

CERTIFIED MAIL # P 773 283 728 RETURN RECEIPT

REPLY TO: 6W-SU

Mr. I.O. Coleman  
Hoechst Celanese Chemical Group, Inc.  
P.O. Box 509  
Bay City, Texas 77414

Dear Mr. Coleman:

We have reviewed your request for a reissuance of the approved no migration petition for the injection wells at the Bay City facility. Based upon the detailed review of all pertinent information regarding this request, I am proposing to approve the reissuance. Enclosed is the public notice and the fact sheet document associated with the proposed decision. A final decision regarding this petition reissuance will be made after the end of the public comment period.

If you have any questions or comments regarding this matter, please call Oscar Cabra at (214) 655-7110 or Ronnie Crossland at (214) 655-7160.

Sincerely yours,

A handwritten signature in black ink that appears to read "Kenton Kirkpatrick".

Kenton Kirkpatrick, P.E.  
Acting Director  
Water Management Division (6W)

cc: Tom Roth, Texas Water Commission

PUBLIC NOTICE OF A PROPOSED HAZARDOUS WASTE  
EXEMPTION REISSUANCE

U.S. ENVIRONMENTAL PROTECTION AGENCY, REGION 6  
FIRST INTERSTATE BANK TOWER  
1445 ROSS AVENUE  
SUITE 1200  
DALLAS, TEXAS 75202-2733

The U.S. Environmental Protection Agency (EPA), Region 6, proposes to approve a reissuance of an exemption to the land disposal restrictions of the Hazardous and Solid Waste Amendments of 1984 (HSWA) to the Resource Conservation and Recovery Act (42 U.S.C. §6901, *et seq*) for the following facility:

Hoechst Celanese Chemical Group, Inc.  
Bay City Plant  
Farm Road 3057, P.O. Box 509  
Bay City, Texas 77414

The land disposal restrictions of the HSWA prohibit the injection of untreated restricted hazardous waste. However, these amendments provide that an exemption to the land disposal restrictions may be granted if the Administrator determines that the method of land disposal (i.e. injection well) is protective of human health and the environment. A method of land disposal may not be determined to be protective, "unless, upon application by an interested person, it has been demonstrated to the Administrator, to a reasonable degree of certainty, that there will be no migration of hazardous constituents from the disposal unit or injection zone for as long as the wastes remain hazardous" [42 U.S.C. § 6924 (g)(5)]. Regulations establishing the criteria for petitioning for an exemption to the land disposal restrictions were published in Volume 53, Number 143 of the Federal Register, July 26, 1988, [53 Fed. Reg., 28118, (1988)]. Hoechst Celanese Chemical Group, Inc., successfully demonstrated no migration for the injection wells at the Bay City facility and obtained an exemption to the land disposal restrictions on May 4, 1990.

The regulations described above also allow for reissuance of the approved petition conditions if the reissuance also meets the no migration criteria in these regulations. Development of the proposed decision was based on a detailed technical review of the submitted reissuance request and support documents. A final decision to approve or deny the reissuance of an exemption to the land disposal restrictions will be made after the close of the comment period, which ends at close of business on November 18, 1991.

Any interested person may request a public hearing on the proposed reissuance decision. The request must be in writing and must include the requester's statement of the issues cited for discussion at the hearing. The request for public hearing must also be submitted to the Dallas office. EPA will give at least 30 days notice of the public hearing, if a hearing is to be held.

Written comments, requests for information regarding the proposed decision on the reissuance, and requests for copies of the fact sheet (description of the reasons supporting the proposed decision) should be sent to EPA Region 6 at the following address:

U.S. Environmental Protection Agency - Region 6  
Water Supply Branch (6W-SU)  
1445 Ross Avenue  
Dallas, Texas 75202-2733  
(214) 655-7160

The administrative record for this modification decision is available for review between 8:00 a.m. and 4:00 p.m., Monday through Friday, for the extent of the comment period, at the address above. A copy of the final petition and modification documentation is also available for review at the:

Bay City Public Library  
1900 5th Street  
Bay City, Texas 77414  
(409) 245-6931

Pertinent EPA comment and public hearing procedures may be found in 40 CFR 124.10 and 124.12.

The EPA will notify the applicant and each person who has submitted written comments of the final reissuance decision. The final decision will also be published in the Federal Register.

October 3, 1991

FACT SHEET

For proposed approval of a reissuance of a previously approved exemption to the land disposal restrictions for the following injection wells:

Applicant: Hoechst Celanese Chemical Group, Inc.  
Bay City Plant  
Farm Road 3057, P.O. Box 509  
Bay City, Texas 77414

Facility Location: Matagorda County, Texas

Permit Numbers: WDW-14, WDW-32, WDW-49, WDW-110, WDW-277

Well Numbers: 2, 3, 4, 1-A, 5

Issuing Office: U.S. Environmental Protection Agency  
Region 6  
First Interstate Bank Tower  
1445 Ross Avenue  
Dallas, Texas 75202-2733

1. The Environmental Protection Agency (EPA) proposes to approve a request for an exemption reissuance to increase the range of the specific gravity of the injected waste stream and to include an additional injection well.
2. This fact sheet or similar statement of basis is required under Title 40 of the Code of Federal Regulations, § 124.7 and 124.8 (40 CFR 124.3 and 124.8, as referenced by 40 CFR § 148.22 and 124.10).
3. The following is an explanation of the derivation of the proposed decision.

Summary

The EPA land disposal restrictions promulgated under § 3004 of the Resource Conservation and Recovery Act prohibit the injection of hazardous waste unless a petitioner demonstrates to the EPA that there will be no migration of hazardous constituents from the injection zone for as long as the waste remains hazardous. These no-migration demonstrations include a description of the well operations, geologic siting, and waste stream characteristics. They also include modeling strategies which incorporate all the above mentioned information and utilize mathematical equations to predict pressure build up and waste movement. Celanese successfully demonstrated no migration for the injection wells at the Bay City facility and obtained an exemption to the land disposal restrictions on May 4, 1990.

ENCLOSURE C CONT'D

Celanese Bay City has requested to expand the specific gravity range for the waste stream injected into the Upper and Lower Miocene formations. The approved petition currently specifies that the specific gravity of the injected fluid must lie within the range of 1.0032 to 1.0054 at 68°F. The requested specific gravity range is 1.00 to 1.10 at 68°F. Celanese remodeled the plume movement based on the requested specific gravity range. This additional modeling indicated that the plume would move farther during the 10,000 year time period than indicated in the original model. For this reason, an exemption reissuance is required instead of a modification. Therefore, all aspects of the petition are open to public comment.

As part of the exemption reissuance, the Bay City Plant also requested to add an additional well, WDW-277, to the Petition Exemption. This well, if drilled, would be located near WDW-110 and also inject into the Lower Miocene Formation. Injection rates for the Lower Miocene Formation are restricted to a monthly cumulative maximum average injection rate based on 400 gallons per minute. All aspects of modeling and operation for this well were covered in the original no migration demonstration.

The waste stream in the reissued petition will be identical to the injectate in the original petition in every respect except specific gravity. Therefore, there will be no change in molecular diffusion rates of individual constituents in the waste stream, or in the compatibility of the waste with the formation or formation fluid. The non-endangerment standard demonstrated in the initial petition will still be valid for vertical waste movement.

Celanese Bay City demonstrated that increasing the specific gravity range for the waste stream would result in no migration of hazardous constituents from the injection zone for a 10,000 year period, as required in 40 CFR Part 148. Based on the remodeling for the reissuance request, the maximum updip plume movement did not change. However, this modeling resulted in an additional downdip plume movement of approximately 6300'. The expanded plume area was reviewed with respect to the geology and to determine if any additional artificial penetrations will be encountered by the plume. The artificial penetration review was performed based on the specific protocol that is defined in the reissuance request. Only one additional well was identified within the plume area. This well was properly plugged to prevent migration of waste from the injection zone.

Therefore, the EPA is proposing to change the Petition Approval Conditions as shown below. (All additions have been underlined).

ENCLOSURE C CONT'D

1. This exemption is for the four existing injection wells WDW-14, WDW-32, WDW-49 and WDW-110. The exemption also includes WDW-277. All wells were permitted by the Texas Water Commission.
2. Injection of restricted waste shall be limited to the injection intervals for the following wells:

Well No. WDW-14	3350 to 3600 feet. (log depth)
Well No. WDW-32	3350 to 3600 feet. (log depth)
Well No. WDW-49	3350 to 3600 feet. (log depth)
Well No. WDW-110	5700 to 5950 feet. (log depth)
<u>Well No. WDW-277</u>	<u>Equivalent interval to 5700 to 5950 feet in WDW-110</u>

These injection intervals occur in an injection zone occurring at a depth of 2900 feet to 6200 feet (log depth).

3. The cumulative monthly volume injected in WDW-14, WDW-32, and WDW-49 shall not exceed 33,480,000 gallons. The monthly volume injected in WDW-110 alone shall not exceed 26,784,000 gallons. The cumulative monthly volume injected in WDW-110 and WDW-277 (if drilled) shall not exceed 17,856,000 gallons.
4. The facility shall cease injection of restricted hazardous waste by December 31, 2000.
5. The characteristics of the injected waste stream other than specific gravity shall at all times conform to those of Section 2.1 in the petition. The specific gravity of the waste stream shall remain within a range of 1.00 to 1.10 at 68°F inclusive.
6. The final approval for injection is limited to the following hazardous wastes: K009, K010, D001, D002, U001, U002, U031, U112, U123, U140, U154, U197, U226, F001, F002, Hexavalent Chromium.
7. Hoechst Celanese must petition for approval to inject additional hazardous wastes which are not included in Condition No. 6, above. Hoechst Celanese must also petition for approval to increase the concentration of any waste which would necessitate the recalculation of the limiting concentration reduction factor and the extent of the waste plume. Petition modifications and reissuance should be made pursuant to 40 CFR 148.20 (e) or (f).

ENCLOSURE C CON'D

8. Hoechst Celanese shall annually submit to EPA the results of bottom hole pressure surveys for WDW-14, WDW-32, WDW-49, WDW-110, and WDW-277 (if drilled). These surveys shall have been performed after shutting in each well for a period of time sufficient to allow the pressure in the injection interval to reach equilibrium, in accordance with 40 CFR 146.68 (e)(1). This annual report should include a comparison of reservoir parameters determined from the falloff tests with parameters used in the approved no migration petition.
9. Upon the expiration, cancellation, reissuance, or modification of the Texas Water Commission's Underground Injection Control permit for Well Nos. WDW-14, WDW-32, WDW-49, WDW-110, and WDW-277 (if drilled) this exemption is subject to review. A new demonstration may be required if information shows that the basis of granting the exemption is no longer valid.
10. Injection well WDW-277 must meet the requirements of the Texas Water Commission injection permit. Results of the pressure and radioactive tracer tests must be submitted to the EPA Region 6 for approval, and if approved, the exemption will become effective and Agency authorization to begin injection of restricted hazardous waste in the WDW-277 injection well will be issued.
11. Information obtained from the drilling and construction of the WDW-277 injection well shall be submitted to the EPA Region 6 to ensure the basis for the petition approval continues to remain valid. This information should include well logs, geologic core analysis of the confining and injection zones, a hydrogeologic compatibility determination, and formation tests.
12. The drilling mud used in the drilling process of the WDW-277 injection well shall be properly disposed.



CERTIFIED MAIL # P 773 283 808 RETURN RECEIPT REQUESTED

Mr. I.O. Coleman  
Hoechst Celanese Chemical Group, Incorporated  
P.O. Box 509  
Bay City, Texas 77404-0509

Re: Final Hoechst Celanese Chemical Group, Incorporated Petition  
Reissuance Decision

Dear Mr. Coleman:

Effective the date of this letter, the Environmental Protection Agency (EPA) approves the Hoechst Celanese Chemical Group, Incorporated, Bay City petition reissuance for an exemption to the land disposal restrictions imposed by the Hazardous and Solid Waste Amendments of 1984 to the Resource Conservation and Recovery Act.

The land disposal restrictions prohibit the injection of hazardous waste unless a petitioner can demonstrate to the EPA, to a reasonable degree of certainty, that there will be no migration of hazardous constituents from the injection zone for as long as the wastes remain hazardous. The land disposal restrictions for injection wells which are codified in 40 CFR Part 148, provide the standards and procedures by which petitions to dispose of an otherwise prohibited waste by injection will be reviewed and by which exemptions pursuant to these petitions will be granted or denied.

A letter dated October 3, 1991, informed Hoechst Celanese that the EPA would propose to approve the request for reissuance of the Bay City petition for an exemption to the land disposal restrictions. The public comment period associated with this proposed decision began on October 3, 1991, and closed on November 18, 1991.

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:FILE CODE:WAT 18-6-5-9

6W-SU 6W-SU 6W-SU 6C-W 6C-W 6C  
DELLINGER CROSSLAND CABRA RANKIN COLLINS ALEXANDER

DD 11/27/91

ROC  
12/3/91

DP  
12/10

DK  
12/10

PA  
12/10/91

MD  
12/10

Based on a detailed technical review of the submitted request for a petition reissuance and support documents, the EPA has determined that this information for the Hoechst Celanese Bay City facility meets the requirements of 40 CFR Part 148 demonstrating no migration of hazardous constituents from the injection zone for 10,000 years.

The following are conditions of this land disposal restriction exemption:

Petition Approval Conditions

The approval to allow injection of restricted hazardous wastes is subject to the following conditions. Noncompliance with any of these conditions is grounds for termination of the exemption in accordance with §148.24(a)(1).

1. This exemption is for the four existing injection wells WDW-14, WDW-32, WDW-49 and WDW-110. The exemption also includes WDW-277. All wells are permitted by the Texas Water Commission.
2. Injection of restricted waste shall be limited to the injection intervals for the following wells:

Well No. WDW-14	3350 to 3600 feet. (log depth)
Well No. WDW-32	3350 to 3600 feet. (log depth)
Well No. WDW-49	3350 to 3600 feet. (log depth)
Well No. WDW-110	5700 to 5950 feet. (log depth)
Well No. WDW-277	Equivalent interval to 5700 to 5950 feet in WDW-110

These injection intervals occur in an injection zone occurring at a depth of 2900 feet to 6200 feet (log depth).

3. The cumulative monthly volume injected in WDW-14, WDW-32, and WDW-49 shall not exceed 33,480,000 gallons. The monthly volume injected in WDW-110 alone shall not exceed 26,784,000 gallons. The cumulative monthly volume injected in WDW-110 and WDW-277 (if drilled) shall not exceed 17,856,000 gallons.
4. The facility shall cease injection of restricted hazardous waste by December 31, 2000.

5. The characteristics of the injected waste stream other than specific gravity shall at all times conform to those of Section 2.1 in the petition. The specific gravity of the waste stream shall remain within a range of 1.00 to 1.10 at 68°F inclusive.
6. The final approval for injection is limited to the following hazardous wastes: K009, K010, D001, D002, U001, U002, U031, U112, U123, U140, U154, U197, U226, F001, F002, Hexavalent Chromium.
7. Hoechst Celanese must petition for approval to inject additional hazardous wastes which are not included in Condition No. 6, above. Hoechst Celanese must also petition for approval to increase the concentration of any waste which would necessitate the recalculation of the limiting concentration reduction factor and the extent of the waste plume. Petition modifications and reissuance should be made pursuant to 40 CFR 148.20 (e) or (f).
8. Hoechst Celanese shall annually submit to EPA the results of bottom hole pressure surveys for WDW-14, WDW-32, WDW-49, WDW-110, and WDW-277 (if drilled). These surveys shall have been performed after shutting in each well for a period of time sufficient to allow the pressure in the injection interval to reach equilibrium, in accordance with 40 CFR 146.68 (e)(1). This annual report should include a comparison of reservoir parameters determined from the falloff tests with parameters used in the approved no migration petition.
9. Upon the expiration, cancellation, reissuance, or modification of the Texas Water Commission's Underground Injection Control permit for Well Nos. WDW-14, WDW-32, WDW-49, WDW-110, and WDW-277 (if drilled) this exemption is subject to review. A new demonstration may be required if information shows that the basis of granting the exemption is no longer valid.
10. Injection well WDW-277 must meet the requirements of the Texas Water Commission injection permit. Results of the pressure and radioactive tracer tests must be submitted to the EPA Region 6 for approval, and if approved, the exemption will become effective and Agency authorization to begin injection of restricted hazardous waste in the WDW-277 injection well will be issued.

11. Information obtained from the drilling and construction of the WDW-277 injection well shall be submitted to the EPA Region 6 to ensure the basis for the petition approval continues to remain valid. This information should include well logs, geologic core analysis of the confining and injection zones, a hydrogeologic compatibility determination, and formation tests.
12. The drilling mud used in the drilling process of the WDW-277 injection well shall be properly disposed.

In addition to the above conditions, this petition reissuance approval is contingent upon the validity of the information submitted in the Hoechst Celanese Chemical Group, Incorporated petition reissuance for an exemption to the land disposal restrictions. This approval is subject to termination where new information shows that the basis for approval of the petition is no longer valid, which is in accordance with §148.24(a)(3).

If you have any questions or comments, please call Oscar Cabra at (214) 655-7110.

Sincerely yours,

Myron O. Knudson, P.E.  
Director  
Water Management Division (6W)

cc: Francoise Brasier (WH-550E)  
Tom Roth, Texas Water Commission

bcc: P. Charles, 6X  
B. Goetz, 6X  
G. Alexander, 6C  
M. Knudson, 6W  
K. Kirkpatrick, 6W  
R. Crossland, 6W-SU

December 11, 1991

HOECHST CELANESE CORPORATION  
NO MIGRATION PETITION REISSUANCE  
PUBLIC COMMENT RESPONSE SUMMARY

The land disposal restrictions prohibit the injection of hazardous waste unless a petitioner demonstrates to the Environmental Protection Agency (EPA), to a reasonable degree of certainty, that there will be no migration of hazardous constituents from the injection zone for as long as the waste remains hazardous. These no migration demonstrations include a description of the well operations, geologic siting, and waste stream characteristics. They also include a modeling strategy which incorporates all the above mentioned information and utilizes mathematical equations to predict pressure buildup and waste movement.

On October 4, 1991, the EPA proposed to approve the request for reissuance of the Hoechst Celanese Corporation's Bay City, Texas petition for an exemption to the land disposal restrictions. The public comment period associated with this proposed decision began on October 4, and closed on November 18, 1991.

The following is a summary of the Agency's response to public concerns regarding the proposed decision on IMC's petition.

1. **Comment:** The exemption reissuance should only be approved for a five-year period to be consistent with the Texas Water Commission permit for Well WDW-277 which was issued in July, 1991.

**Response:** The regulations in 40 CFR Part 148 do not require an exemption to the land disposal restrictions to match all of the State permit restrictions. However, under 40 CFR Part 148.21, when considering whether to reissue a permit for the operation of a Class I hazardous waste injection well, the Director shall review any petition filed pursuant to 148.20 and require a new demonstration if information shows that the basis for granting the exemption may no longer be valid.

NOV 11 1991

REPLY TO: 6W-SU

MEMORANDUM

SUBJECT: Federal Register Notice - Final Decision on the Hoechst Celanese Chemical Group, Incorporated Petition Reissuance

FROM: Oscar Cabra, Jr., P.E.  
Chief  
Municipal Facilities Branch (6W-M)

TO: Vicki Reed  
Office of Standards and Regulations (PM-223)

Attached are three originals of our Federal Register Notice and a signed original of the Federal Register Typesetting Request. This Federal Register Notice concerns the final decision on the reissuance of the approved Hoechst Celanese Chemical Group Incorporated, petition for an exemption to the land disposal restrictions for the Bay City, Texas facility. Please review these documents and submit them for publication at your earliest convenience. Please notify us by phone when you have an estimated date for publication.

If you have any questions or if any changes are necessary, please call Ronnie Crossland at FTS 255-7160 or Minnie Howard at FTS 255-7165.

Attachments

MDW 11/27/91  
6WSU:11/27/91:HOWARD:CE:C:\WP50\CELANESE\CELANESE.BA\REIFEDRG.MEM  
FILE CODE:WAT 18-6-5-9

6W-SU            6W-S  
CROSSLAND        CABRA

ROC

12/3/91

(Billing Code: )

ENVIRONMENTAL PROTECTION AGENCY

Underground Injection Control Program

Hazardous Waste Disposal Injection Restrictions;

Petition for Exemption - Class I Hazardous Waste  
Injection

Hoechst Celanese Chemical Group, Incorporated

AGENCY: Environmental Protection Agency

ACTION: Notice of Final Decision on Petition  
Reissuance

SUMMARY: Notice is hereby given that a reissuance to an exemption to the land disposal restrictions under the 1984 Hazardous and Solid Waste Amendments to the Resource Conservation and Recovery Act has been granted to Hoechst Celanese Chemical Group, Incorporated, for the Class I injection wells located at Bay City, Texas. As required by 40 CFR Part 148, the company has adequately demonstrated to the satisfaction of the Environmental Protection Agency by petition and supporting documentation that, to a reasonable degree of certainty, there will be no migration of hazardous constituents from the injection zone for as long as the waste remains hazardous. This final decision allows the underground injection by Hoechst Celanese Chemical Group, Incorporated, of the specific restricted hazardous waste identified in the petition reissuance,

into the Class I hazardous waste injection wells at the Bay City, Texas facility specifically identified in the reissued petition, for as long as the basis for granting an approval of this petition remains valid, under provisions of 40 CFR 148.24. As required by 40 CFR 124.10, a public notice was issued October 3, 1991. The public comment period ended on November 18, 1991. All comments have been addressed and have been considered in the final decision. This decision constitutes final Agency action and there is no Administrative appeal.

DATES: This action is effective as of December 11, 1991 .

ADDRESSES: Copies of the reissued petition and all pertinent information relating thereto are on file at the following location:

Environmental Protection Agency, Region 6

Water Management Division

Water Supply Branch (6W-SU)

1445 Ross Avenue

Dallas, Texas 75202-2733

FOR FURTHER INFORMATION CONTACT: Oscar Cabra, Jr., Chief Municipal Facilities Branch, EPA - Region 6, telephone (214) 655-7110, (FTS) 255-7110.

Myron O. Knudson  
Myron O. Knudson, P.E.  
Director





EPA REGION 6  
DALLAS, TEXAS

**FAX**

**TO:**

I. O. Coleman  
NAME

OFFICE

Celanese  
ORGANIZATION

**FAX #:**

(409) 245-4871  
~~(409) 245-4086~~ 4194

**TELEPHONE #:**

(409) 245-4871

**FROM:**

Minnie Howard  
NAME

MAIL CODE

WATER MANAGEMENT DIVISION

**FAX #:**

(214) 655-6490

FTS 255-6490

**TELEPHONE #:**

(214) 655-7165

FTS 255-

**SENT:**

12/11/91

DATE

TIME

**# PAGES:**

6

INCLUDES COVER SHEET

**DESCRIPTION:**

Final Decision-Reissuance

X6

001 03 1001

CERTIFIED MAIL # P 773 283 728 RETURN RECEIPT

REPLY TO: 6W-SU

Mr. I.O. Coleman  
Hoechst Celanese Chemical Group, Inc.  
P.O. Box 509  
Bay City, Texas 77414

Dear Mr. Coleman:

We have reviewed your request for a reissuance of the approved no migration petition for the injection wells at the Bay City facility. Based upon the detailed review of all pertinent information regarding this request, I am proposing to approve the reissuance. Enclosed is the public notice and the fact sheet document associated with the proposed decision. A final decision regarding this petition reissuance will be made after the end of the public comment period.

If you have any questions or comments regarding this matter, please call Oscar Cabra at (214) 655-7110 or Ronnie Crossland at (214) 655-7160.

Sincerely yours,

Kenton Kirkpatrick, P.E.  
Acting Director  
Water Management Division (6W)

cc: Tom Roth, Texas Water Commission

(10/12/91) PD 10/1/91  
6W-SU:HOWARD:CE:09-30-91:C:\CELANESE.BA\MODRE.LTR  
FILE CODE: Wat 18-6-5-9

6W-SU 6W-M 6C-W 6C-W 6C  
CROSSLAND CABRA RANKIN COLLINS ALEXANDER

KDL  
10/2/91

for RDC  
10/3/91

RPB  
10/2/91

10/2/91

10/2/91

PUBLIC NOTICE OF A PROPOSED HAZARDOUS WASTE  
EXEMPTION REISSUANCE

U.S. ENVIRONMENTAL PROTECTION AGENCY, REGION 6  
FIRST INTERSTATE BANK TOWER  
1445 ROSS AVENUE  
SUITE 1200  
DALLAS, TEXAS 75202-2733

The U.S. Environmental Protection Agency (EPA), Region 6, proposes to approve a reissuance of an exemption to the land disposal restrictions of the Hazardous and Solid Waste Amendments of 1984 (HSWA) to the Resource Conservation and Recovery Act (42 U.S.C. §6901, et seq) for the following facility:

Hoechst Celanese Chemical Group, Inc.  
Bay City Plant  
Farm Road 3057, P.O. Box 509  
Bay City, Texas 77414

The land disposal restrictions of the HSWA prohibit the injection of untreated restricted hazardous waste. However, these amendments provide that an exemption to the land disposal restrictions may be granted if the Administrator determines that the method of land disposal (i.e. injection well) is protective of human health and the environment. A method of land disposal may not be determined to be protective, "unless, upon application by an interested person, it has been demonstrated to the Administrator, to a reasonable degree of certainty, that there will be no migration of hazardous constituents from the disposal unit or injection zone for as long as the wastes remain hazardous" [42 U.S.C. § 6924 (g)(5)]. Regulations establishing the criteria for petitioning for an exemption to the land disposal restrictions were published in Volume 53, Number 143 of the Federal Register, July 26, 1988, [53 Fed. Reg., 28118, (1988)]. Hoechst Celanese Chemical Group, Inc., successfully demonstrated no migration for the injection wells at the Bay City facility and obtained an exemption to the land disposal restrictions on May 4, 1990.

The regulations described above also allow for reissuance of the approved petition conditions if the reissuance also meets the no migration criteria in these regulations. Development of the proposed decision was based on a detailed technical review of the submitted reissuance request and support documents. A final decision to approve or deny the reissuance of an exemption to the land disposal restrictions will be made after the close of the comment period, which ends at close of business on November 18, 1991.

Any interested person may request a public hearing on the proposed reissuance decision. The request must be in writing and must include the requester's statement of the issues cited for discussion at the hearing. The request for public hearing must also be submitted to the Dallas office. EPA will give at least 30 days notice of the public hearing, if a hearing is to be held.

Written comments, requests for information regarding the proposed decision on the reissuance, and requests for copies of the fact sheet (description of the reasons supporting the proposed decision) should be sent to EPA Region 6 at the following address:

U.S. Environmental Protection Agency - Region 6  
Water Supply Branch (6W-SU)  
1445 Ross Avenue  
Dallas, Texas 75202-2733  
(214) 655-7160

The administrative record for this modification decision is available for review between 8:00 a.m. and 4:00 p.m., Monday through Friday, for the extent of the comment period, at the address above. A copy of the final petition and modification documentation is also available for review at the:

Bay City Public Library  
1900 5th Street  
Bay City, Texas 77414  
(409) 245-6931

Pertinent EPA comment and public hearing procedures may be found in 40 CFR 124.10 and 124.12.

The EPA will notify the applicant and each person who has submitted written comments of the final reissuance decision. The final decision will also be published in the Federal Register.

October 3, 1991

FACT SHEET

For proposed approval of a reissuance of a previously approved exemption to the land disposal restrictions for the following injection wells:

Applicant: Hoechst Celanese Chemical Group, Inc.  
Bay City Plant  
Farm Road 3057, P.O. Box 509  
Bay City, Texas 77414

Facility Location: Matagorda County, Texas

Permit Numbers: WDW-14, WDW-32, WDW-49, WDW-110, WDW-277

Well Numbers: 2, 3, 4, 1-A, 5

Issuing Office: U.S. Environmental Protection Agency  
Region 6  
First Interstate Bank Tower  
1445 Ross Avenue  
Dallas, Texas 75202-2733

1. The Environmental Protection Agency (EPA) proposes to approve a request for an exemption reissuance to increase the range of the specific gravity of the injected waste stream and to include an additional injection well.
2. This fact sheet or similar statement of basis is required under Title 40 of the Code of Federal Regulations, § 124.7 and 124.8 (40 CFR 124.8 and 124.8, as referenced by 40 CFR § 148.22 and 124.10).
3. The following is an explanation of the derivation of the proposed decision.

Summary

The EPA land disposal restrictions promulgated under § 3004 of the Resource Conservation and Recovery Act prohibit the injection of hazardous waste unless a petitioner demonstrates to the EPA that there will be no migration of hazardous constituents from the injection zone for as long as the waste remains hazardous. These no-migration demonstrations include a description of the well operations, geologic siting, and waste stream characteristics. They also include modeling strategies which incorporate all the above mentioned information and utilize mathematical equations to predict pressure build up and waste movement. Celanese successfully demonstrated no migration for the injection wells at the Bay City facility and obtained an exemption to the land disposal restrictions on May 4, 1990.

Celanese Bay City has requested to expand the specific gravity range for the waste stream injected into the Upper and Lower Miocene formations. The approved petition currently specifies that the specific gravity of the injected fluid must lie within the range of 1.0032 to 1.0054 at 68°F. The requested specific gravity range is 1.00 to 1.10 at 68°F. Celanese remodeled the plume movement based on the requested specific gravity range. This additional modeling indicated that the plume would move farther during the 10,000 year time period than indicated in the original model. For this reason, an exemption reissuance is required instead of a modification. Therefore, all aspects of the petition are open to public comment.

As part of the exemption reissuance, the Bay City Plant also requested to add an additional well, WDW-277, to the Petition Exemption. This well, if drilled, would be located near WDW-110 and also inject into the Lower Miocene Formation. Injection rates for the Lower Miocene Formation are restricted to a monthly cumulative maximum average injection rate based on 400 gallons per minute. All aspects of modeling and operation for this well were covered in the original no migration demonstration.

The waste stream in the reissued petition will be identical to the injectate in the original petition in every respect except specific gravity. Therefore, there will be no change in molecular diffusion rates of individual constituents in the waste stream, or in the compatibility of the waste with the formation or formation fluid. The non-endangerment standard demonstrated in the initial petition will still be valid for vertical waste movement.

Celanese Bay City demonstrated that increasing the specific gravity range for the waste stream would result in no migration of hazardous constituents from the injection zone for a 10,000 year period, as required in 40 CFR Part 148. Based on the remodeling for the reissuance request, the maximum updip plume movement did not change. However, this modeling resulted in an additional downdip plume movement of approximately 6300'. The expanded plume area was reviewed with respect to the geology and to determine if any additional artificial penetrations will be encountered by the plume. The artificial penetration review was performed based on the specific protocol that is defined in the reissuance request. Only one additional well was identified within the plume area. This well was properly plugged to prevent migration of waste from the injection zone.

Therefore, the EPA is proposing to change the Petition Approval Conditions as shown below. (All additions have been underlined).

1. This exemption is for the four existing injection wells WDW-14, WDW-32, WDW-49 and WDW-110. The exemption also includes WDW-277. All wells were permitted by the Texas Water Commission.
2. Injection of restricted waste shall be limited to the injection intervals for the following wells:

Well No. WDW-14	3350 to 3600 feet. (log depth)
Well No. WDW-32	3350 to 3600 feet. (log depth)
Well No. WDW-49	3350 to 3600 feet. (log depth)
Well No. WDW-110	5700 to 5950 feet. (log depth)
<u>Well No. WDW-277</u>	<u>Equivalent interval to 5700 to 5950 feet in WDW-110</u>

These injection intervals occur in an injection zone occurring at a depth of 2900 feet to 6200 feet (log depth).

3. The cumulative monthly volume injected in WDW-14, WDW-32, and WDW-49 shall not exceed 33,480,000 gallons. The monthly volume injected in WDW-110 alone shall not exceed 26,784,000 gallons. The cumulative monthly volume injected in WDW-110 and WDW-277 (if drilled) shall not exceed 17,856,000 gallons.
4. The facility shall cease injection of restricted hazardous waste by December 31, 2000.
5. The characteristics of the injected waste stream other than specific gravity shall at all times conform to those of Section 2.1 in the petition. The specific gravity of the waste stream shall remain within a range of 1.00 to 1.10 at 68°F inclusive.
6. The final approval for injection is limited to the following hazardous wastes: K009, K010, D001, D002, U001, U002, U031, U112, U123, U140, U154, U197, U226, F001, F002, Hexavalent Chromium.
7. Hoechst Celanese must petition for approval to inject additional hazardous wastes which are not included in Condition No. 6, above. Hoechst Celanese must also petition for approval to increase the concentration of any waste which would necessitate the recalculation of the limiting concentration reduction factor and the extent of the waste plume. Petition modifications and reissuance should be made pursuant to 40 CFR 148.20 (e) or (f).

8. Hoechst Celanese shall annually submit to EPA the results of bottom hole pressure surveys for WDW-14, WDW-32, WDW-49, WDW-110, and WDW-277 (if drilled). These surveys shall have been performed after shutting in each well for a period of time sufficient to allow the pressure in the injection interval to reach equilibrium, in accordance with 40 CFR 146.68 (e)(1). This annual report should include a comparison of reservoir parameters determined from the falloff tests with parameters used in the approved no migration petition.
9. Upon the expiration, cancellation, reissuance, or modification of the Texas Water Commission's Underground Injection Control permit for Well Nos. WDW-14, WDW-32, WDW-49, WDW-110, and WDW-277 (if drilled) this exemption is subject to review. A new demonstration may be required if information shows that the basis of granting the exemption is no longer valid.
10. Injection well WDW-277 must meet the requirements of the Texas Water Commission injection permit. Results of the pressure and radioactive tracer tests must be submitted to the EPA Region 6 for approval, and if approved, the exemption will become effective and Agency authorization to begin injection of restricted hazardous waste in the WDW-277 injection well will be issued.
11. Information obtained from the drilling and construction of the WDW-277 injection well shall be submitted to the EPA Region 6 to ensure the basis for the petition approval continues to remain valid. This information should include well logs, geologic core analysis of the confining and injection zones, a hydrogeologic compatibility determination, and formation tests.
12. The drilling mud used in the drilling process of the WDW-277 injection well shall be properly disposed.



EPA REGION 6  
DALLAS, TEXAS

FAX

TO:

Tom Roth

NAME

OFFICE

TWC

ORGANIZATION

FAX #:

(512) 475 - 2215

TELEPHONE # : (512) 463-8250

FROM:

Minnie Howard

NAME

6W-54

MAIL CODE

WATER MANAGEMENT DIVISION

FAX #:

(214) 655-6490

FTS 255-6490

TELEPHONE # :

(214) 655-7165

FTS 255-

SENT:

10/3/91

DATE

TIME

# PAGES:

8

INCLUDES COVER SHEET

DESCRIPTION:

Please place in front of petition

Pub. Not. Celanese - Bay City &  
DuPont - Beaumont, TX



EPA REGION 6  
DALLAS, TEXAS

**FRX**

**TO:**

I. O. Coleman

NAME

OFFICE

Celanese - Bay City

ORGANIZATION

**FAX #:**

(409) 245-4871-4086

**TELEPHONE #:** (409) 245-4871

**FROM:**

Minnie Howard

NAME

6W-54  
MAIL CODE

WATER MANAGEMENT DIVISION

**FAX #:**

(214) 655-6490

FTS 255-6490

**TELEPHONE #:** (214) 655-

FTS 255-

**SENT:**

10/3/91

DATE

TIME

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**DESCRIPTION:**

Pub. Not.

Please Place in Vol. 1 of Petition  
at Library.

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WATER SUPPLY BRANCH

91 MAR 28 PM 12:01

6W-S

March 27, 1991  
IOC-60-91

**Chemical Group**  
Hoechst Celanese Corporation  
Bay City Plant  
PO Box 509, FM 3057  
Bay City, TX 77404-0509  
409 245 4871

Mr. Ronald D. Crossland  
U. S. Environmental Protection Agency  
Region VI (6W-SU)  
1445 Ross Avenue  
Dallas, Texas 75202-2733

**Subject:** Minor Modification Request To Approved No-Migration Petition  
Hoechst Celanese Chemical Group, Inc.  
Bay City Plant, Bay City, Texas  
(Reference Letters, IOC-24-91, IOC-25-91 and IOC-26-91  
Dated February 6 and February 8, 1991 Respectively)

Dear Mr. Crossland:

Per your request during our telephone conversation on Thursday, March 24, 1991, this letter transmits to EPA the Hoechst Celanese Chemical Group, Inc., Bay City Plant's re-submission of its Class I Injection Well Petition exemption modification (for specific gravity) document. This petition exemption modification request is made under "Section II, Exemption Modification, D., Change in Density of Fluids", of the recently issued February EPA guidance document applicable to this issue (UIC Program Guidance #74).

With this submission, the Bay City Plant again requests the EPA to increase the range of specific gravities of the injected fluids, approved in the Bay City Plant Class I Petition exemption.

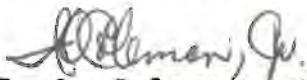
The exemption modification was submitted to EPA February 6, 1991, and was based on the proposed guidance document on petition modifications. The final EPA guidance document, "#74" has now been issued, and a review of the final guidance document indicates that there were no significant changes to the requirements for specific gravity exemption modifications. Thus, in the interest of expediting the exemption approval, no revisions have been made to the exemption modification request document submitted February 6, 1991.

It should be noted that the Bay City Plant is requesting the revised range for injected wastes be given in specific gravities and not in densities. This is because specific gravities are what is customarily measured at the facility. The necessary conversions from density to specific gravity are made in the attached exemption modification document.

There is an imminent land ban date (June 8, 1991, i.e., expiration of 2 year capacity variance) for the waste injected into WDW-110 (Well 1-A). Thus, the plant requests the EPA to expedite this petition exemption modification request, and approve the injecting of the revised range of specific gravities, on or before this June 8, 1991 ban date.

Please don't hesitate to contact by telephone Mr. Ralph D. Riley at (409) 245-4871 or me at extension 4197 if you have any comments or questions concerning this matter.

Very truly yours,



I. O. Coleman, Jr.  
Environmental Affairs, Industrial Hygiene  
and Health Section Leader

IOC/la  
Attachments

cc: Mr. Thomas Roth, Chief - w/o Attach.  
Underground Injection Control Section  
Hazardous and Solid Waste Division  
Texas Water Commission  
P. O. Box 13087, Capitol Station  
1700 North Congress Ave.  
Austin, Texas 78711-3087

Mr. Myron O. Knudson - w/o Attach.  
Deputy Director  
Water Management Division  
United States Environmental Protection Agency  
Region IV, (6W-S)  
1445 Ross Avenue  
Dallas, Texas 75202-2733

Mr. Oscar Cabra, Jr., Chief w/o Attach.  
United States Environmental Protection Agency  
Region IV, (6WS)  
1445 Ross Avenue  
Dallas, Texas 75202-3722

Mr. Richard E. Merritt - w/o Attach.  
Geologist  
Underground Injection Control Section  
Hazardous and Solid Waste Division  
Texas Water Commission  
P. O. Box 13087, Capitol Station  
1700 North Congress Avenue  
Austin, Texas 78711-3087



Mr. Minor Brooks Hibbs, Chief - w/o Attach.  
Permit Section  
Hazardous and Solid Waste Division  
Texas Water Commission  
P. O. Box 13087, Capitol Station  
1700 North Congress Avenue  
Austin, Texas 78711-3087

Mr. Brian Graves - w/o Attach.  
United States Environmental Protection Agency  
Region VI  
1445 Ross Avenue  
Dallas, Texas 75202-273

bcc: C. R. Pennington - w/o Attach.  
H. P. Heathman ---> E. H. Chiu - w/o Attach.  
B. L. Fritz ---> B. A. Logue - w/o Attach.  
G. E. Organ ---> Environmental File No. 202.13  
G. J. McCarthy - w/o Attach.  
R. D. Riley - w/o Attach.  
R. H. Maurer - Dallas - w/o Attach.  
G. R. Dorgant - Dallas - w/o Attach.  
C. J. Schaefer - Dallas - w/o Attach.  
G. M. Rowen - Bridgewater - w/o Attach.  
D. H. Squyres - (Du Pont) - Houston - w/o Attach.



RECEIVED

FEB 12 1991

February 08, 1991  
IOC-26-91

EPA SW-S  
REGION VI

**Chemical Group**  
Hoechst Celanese Corporation  
Bay City Plant  
PO Box 509, FM 3057  
Bay City, TX 77404-0509  
409 245 4871

Mr. Ronald D. Crossland  
U. S. Environmental Protection Agency  
Region VI (6W-SU)  
1445 Ross Avenue  
Dallas, Texas 75202-2733

SUBJECT: No-Migration Minor Petition Modification  
Hoechst Celanese Chemical Group, Inc.,  
Bay City Plant, Bay City, Texas

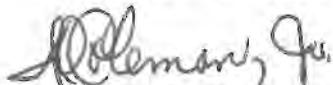
Dear Mr. Crossland:

My letter, IOC-24-91, dated February 6, 1991, has been revised and is submitted to you as IOC-25-91 (attached), dated February 8, 1991. The revised letter, specifically page 2, first paragraph, delineate the correct expressions for density, density units and specific gravity and refers to places in the "Minor Petition Modification" document where these same expressions should be reflected.

In advance, I apologize for any inconvenience that may result due to the above revised letter.

Please contact by telephone Mr. Ralph D. Riley at (409) 245-4871 or me at extension 4197 if you have any comments or questions concerning this matter

Very truly yours,



I. O. Coleman, Jr.  
Environmental Affairs, Industrial hygiene  
and Health Section Leader

IOC/la

**Chemical Group**

Hoechst Celanese Corporation  
Bay City Plant  
PO Box 509, FM 3057  
Bay City, TX 77404-0509  
409 245 4871

February 08, 1991  
IOC-25-91

Mr. Ronald D. Crossland  
U. S. Environmental Protection Agency  
Region VI (6W - SU)  
1445 Ross Avenue  
Dallas, Texas 75202-2733

Subject: No-Migration Minor Petition Modification  
Hoechst Celanese Chemical Group, Inc.,  
Bay City Plant, Bay City, Texas

Dear Mr. Crossland:

As followup to our meeting in your office on Monday, December 17, 1990, I have enclosed herewith a document entitled "Minor Petition Modification", Hoechst Celanese Chemical Group, Inc., Bay City Plant, for your review and consideration. This document was prepared by Du Pont Environmental Remediation Services and supports our request for a minor modification of our approved No-Migration Petition.

Specifically, the Bay City Plant requests a minor modification to expand the specific gravity range of the injected fluids. The Proposed Guidance on Modification of Exemption to Hazardous Waste Disposal Injection Restrictions draft, dated October 31, 1990, developed for and by the Underground Injection Practices Council, was used as reference for analyzing potential requirements to amend our petition.

We currently operate four Class I injection wells. These wells were re-permitted by the Texas Water Commission effective January 13, 1987 through January 13, 1992. Two waste streams are injected: an "acid" waste (hazardous stream) and a "neutral" waste (non hazardous stream). Each stream is injected into a separate well system. WDW-110 injects into the Lower Miocene Injection Sand Interval. WDW-14, WDW-32 and WDW-49 inject into the Upper Miocene Injection Sand Interval. (Also, we have submitted a permit application to TWC for an additional well, WDW-277, which is intended to serve as backup to the existing WDW-110).

We wish to expand the specific gravity range currently specified in our Petition as density by submittal of an exemption modification. Our Petition specifies that the density of injected fluids be within the range of 1.0012 and 1.0034 g/cm<sup>3</sup> at 68°F. The requested specific gravity is 1.00 to 1.10. (Pages 1,5 and 11, Table 2 and Figure 1 of the enclosed modification document should also reflect the following for specific gravity: 1.00 to 1.10 instead of 1.00 to 1.10 g/cm<sup>3</sup> at 68°F). This change is requested based on a demonstration of hydraulic similarity between the initial Petition injectate and the modified injectate (expanded specific gravity range) as reflected by the behavior and characteristics of the formation fluids.

Additional plume modeling, using the high and low values of the proposed density, was performed. The modeling showed that movement of the injected waste plume will not extend significantly beyond the limits defined by modeling in the original petition demonstration. Consequently, there is no significant affect on the no-migration demonstration in our approved Petition.

Since the characteristics of the expanded specific gravity range injectate are sufficiently within (or less dense than) the range of specific gravities modeled in the initial Petition, modification of the exemption to our Petition is justified. (See Figure 1 of the enclosed document.)

In summary, the technical review and approach undertaken to prepare the "Minor Petition Modification" document involved the following:

- \* A review of the Proposed Guidance Document on Modification of Exemptions to Hazardous Waste Disposal Injection Restrictions was made to determine that the requested Petition specific gravity modification is a minor modification.
- \* The 10,000-year plume model was rerun, using the expanded specific gravity range, to determine locations of plumes.
- \* Revised specific gravity plumes were plotted on our approved Petition maps to show any new area covered by these plumes that was not covered by the plumes in the approved Petition.
- \* Review of the revised plume areas was conducted to assure that no additional artificial penetrations were impacted by the revised plume areas.

Based on the above, we feel the requested specific gravity range expansion of injected fluids will not affect the demonstration of no-migration in our approved Petition. Also, since this proposed

bcc: C. R. Pennington - w/o Attach.  
H. P. Heathman ---> E. H. Chiu - w/o Attach.  
B. L. Fritz ---> B. A. Logue - w/o Attach.  
G. E. Organ ---> Environmental File No. 202.13  
G. J. McCarthy - w/o Attach.  
R. D. Riley - w/o Attach.  
R. H. Maurer - Dallas - w/o Attach.  
G. R. Dorgant - Dallas - w/o Attach.  
C. J. Schaefer - Dallas - w/o Attach.  
G. M. Rowen - Bridgewater - w/o Attach.  
D. H. Squyers - (Du Pont) - Houston - w/o Attach.

D

04 MAY 1990

CERTIFIED MAIL  
RETURN RECEIPT REQUESTED

REPLY TO: 6W-SU

Mr. I. O. Coleman  
Environmental Affairs  
Hoechst Celanese Chemical  
Group, Incorporated  
P.O. Box 509  
Bay City, Texas 77414

Re: Final Hoechst Celanese Chemical Group, Incorporated - Bay City, Texas,  
Petition Decision

Dear Mr. Coleman:

Effective the date of this letter, the Environmental Protection Agency (EPA) approves the Hoechst Celanese - Bay City petition for an exemption to the land disposal restrictions imposed by the Hazardous and Solid Waste Amendments of 1984 to the Resource Conservation and Recovery Act. This approval is contingent upon the conditions listed below.

The land disposal restrictions prohibit the injection of hazardous waste unless a petitioner can demonstrate to the EPA, to a reasonable degree of certainty, that there will be no migration of hazardous constituents from the injection zone for as long as the wastes remain hazardous. The land disposal restrictions for injection wells which are codified in 40 CFR Part 148, provide the standards and procedures by which petitions to dispose of an otherwise prohibited waste by injection will be reviewed and by which exemptions pursuant to these petitions will be granted or denied.

A letter dated March 6, 1990, informed Hoechst Celanese that the Environmental Protection Agency (EPA) would propose to approve the Bay City petition for an exemption to the land disposal restrictions. The public comment period associated with this proposed decision began on March 7, 1990, and closed on April 20, 1990. In addition to this comment period, a public hearing was held in Bay City, Texas, on April 12, 1990, to allow the local public the opportunity to present comments concerning the EPA's proposed decision. Enclosed is EPA's response to the issues raised during the public comment period.

Based on a detailed technical review of the submitted petition and support documents, the information presented during the public comment period, and consultations with the Texas Water Commission, the EPA has determined that the Hoechst Celanese - Bay City, petition meets the requirements of 40 CFR Part 148 by demonstrating no migration of hazardous constituents from the injection zone for 10,000 years.

#### Petition Approval Conditions

The final approval to allow injection of restricted hazardous wastes is subject to the following conditions. Noncompliance with any of these conditions is grounds for termination of the exemption in accordance with 40 CFR 148.24(a)(1).

1. This exemption is only for the four injection Wells WDW-14, WDW-32, WDW-49, and WDW-110 which were permitted by the Texas Water Commission.
2. Injection of restricted waste shall be limited to the injection intervals for the following wells:

Well No. WDW-14	3350 to 3600 feet. (log depth)
Well No. WDW-32	3350 to 3600 feet. (log depth)
Well No. WDW-49	3350 to 3600 feet. (log depth)
Well No. WDW-110	5700 to 5950 feet. (log depth)

These injection intervals occur in an injection zone occurring at a depth of 2900 feet to 6200 feet (log depth).

3. The cumulative monthly volume injected in WDW-14, WDW-32, and WDW-49 shall not exceed 33,480,000 gallons. The monthly volume injected in WDW-110 shall not exceed 26,784,000 gallons.
4. The facility shall cease injection of restricted hazardous waste by December 31, 2000.
5. The characteristics of the injected waste stream shall at all times conform to those of Section 2.1 in the petition. The density of the waste stream shall remain within a range of from 1.0012 to 1.0034, inclusive.
6. The final approval for injection is limited to the following hazardous wastes: K009, K010, D001, D002, U001, U002, U031, U112, U123, U140, U154, U197, U226, F001, F002, Hexavalent Chromium.

7. Hoechst Celanese must petition for approval to inject additional hazardous wastes which are not included in Condition No. 6, above. Hoechst Celanese must also petition for approval to increase the concentration of any waste which would necessitate the recalculation of the limiting concentration reduction factor and the extent of the waste plume. Petition modifications and reissuance should be made pursuant to 40 CFR 148.20 (e) or (f).
8. Hoechst Celanese shall annually submit to EPA the results of a bottom hole pressure survey for WDW-14, WDW-32, WDW-49, and WDW-110. This survey shall have been performed after shutting in each well for a period of time sufficient to allow the pressure in the injection interval to reach equilibrium, in accordance with 40 CFR 146.68(e)(1).
9. Upon the expiration, cancellation, reissuance, or modification of the Texas Water Commission's Underground Injection Control permit for Well No(s). WDW-14, WDW-32, WDW-49 and WDW-110, this exemption is subject to review. A new demonstration may be required if information shows that the basis of granting the exemption is no longer valid.

In addition to the above conditions, this final petition approval is contingent upon the validity of the information submitted in the Hoechst Celanese - Bay City petition for an exemption to the land disposal restrictions. This approval is subject to termination where new information shows that the basis for approval of the petition is no longer valid, which is in accordance with Section 148.24(a)(3).

If you have any questions or comments, please call Oscar Cabra, Jr., at (214) 655-7150.

Sincerely yours,

Myron O. Knudson, P.E.  
Director  
Water Management Division (6W)

4

Enclosures

cc: Michael Cook (WH-550A)  
Francoise Brasier (WH-550E)  
Texas Water Commission

bcc: P. Charles, 6X  
B. Goetz, 6X  
G. Alexander, 6C  
A. Davis, 6H  
M. Knudson, 6W  
K. Kirkpatrick, 6W  
V. Malott, 6W-SU  
M. Howard, 6W-SU  
S. Parrish, 6W-SU  
M. Weaver, 6W-SU

6W-SU:5/02/90:HOWARD:BT:C/VM:CELA-HOE.LTR:FILE CODE:  
WAT18-6-5-10 SEC 1.

*6W-SU*  
Parish

*6C-W:*  
Rankin

*6C:*  
Alexander  
*PA 5/4/90*

*6W-S*  
Cabra  
*5/4*  
6W-SU  
Crossland  
*PA 5/4/90*

*(R.O.) 5/4*

May 4, 1990

HOECHST CELANESE CHEMICAL GROUP, INC.  
BAY CITY, TEXAS PLANT  
NO MIGRATION PETITION  
PUBLIC COMMENT RESPONSE SUMMARY

The land disposal restrictions prohibit the injection of hazardous waste unless a petitioner demonstrates to the Environmental Protection Agency (EPA), to a reasonable degree of certainty, that there will be no migration of hazardous constituents from the injection zone for as long as the waste remains hazardous. These no migration demonstrations include a description of the well operations, geologic siting, and waste stream characteristics. They also include a modeling strategy which incorporates all the above mentioned information and utilizes mathematical equations to predict pressure build up and waste movement.

On March 7, 1990, the EPA proposed to approve the Hoechst Celanese - Bay City petition for an exemption to the land disposal restrictions. The public comment period associated with this proposed decision began on March 7, 1990, and was closed on April 20, 1990. In addition to this comment period, a public hearing was held in Bay City, Texas, on April 12, 1990, to allow the local public the opportunity to present comments concerning the EPA's proposed decision.

The following is a summary of the Agency's response to public concerns regarding the proposed decision on the Hoechst Celanese - Bay City petition.

1. Comment: Granting an exemption undermines Congressional policy of 1984, whereby land disposal of hazardous waste was disapproved as a disposal alternative. The law was written to avoid exemptions and phase out deep well injection. No more wells should be permitted and existing wells should be phased out within 10 years. For the good of the public health and environment, no exemption should be approved.

Response: The Hazardous and Solid Waste Amendments (HSWA) of 1984 provided for the eventual prohibition of hazardous wastes by a number of methods of land disposal, among them deep well underground injection. However, HSWA also provides for variances from these prohibitions. A no migration demonstration is but one of several variances established by Congress to allow land disposal of

Hoechst Celanese - Bay City

hazardous waste to continue provided there is no threat to human health and the environment. Hoechst Celanese has demonstrated that there will be no migration of restricted hazardous wastes out of the injection zone, therefore this disposal unit is safe to human health and the environment.

**2. Comment:** Granting exemptions violates EPA's own waste minimization policy and does not promote waste reduction, recovery, or recycling. Numerous waste treatment technologies are available and when faced with stiffer and more restrictive waste disposal laws, industry can find improved means of disposal or new ways of treatment. It is better to treat the waste and make it innocuous than to inject it into a deep well to create a problem for future generations.

**Response:** Congress authorized EPA to exempt certain units which meet the stringent standards in RCRA 3004(f) and (g) from the pretreatment requirements in 3004(m). EPA believes injection into such a well, which meets these requirements, will not create problems for future generations.

**3. Comment:** A commenter drew an analogy between injection wells, incineration, and leaking landfills, asserting that since incineration and landfills were being phased out, so should injection wells.

**Response:** The Agency does not believe a useful comparison can be made between a landfill, incineration, and a hazardous waste injection well. The injection well is specifically designed to emplace fluids deep beneath the surface in order to prevent any contamination of drinking water supplies. Construction, well testing, waste compatibility, and monitoring requirements are some requirements imposed on injection wells which makes their continued operation safe. Response No. 1 further outlines the variance that applies to injection wells.

**4. Comment:** The future cost of cleanups from injection wells will be enormous, as in Superfund. Funds are inadequate and EPA cannot keep up with its mandated duties. Significant fees should be

Hoechst Celanese - Bay City

placed on no migration permits to encourage cessation of this method of disposal.

**Response:** The current preventative regulations imposed on deep injection wells will prevent releases from the injection well and injection zone. Financial responsibility requirements for well closure and post-closure care are found in 40 CFR Part 146. There is no regulatory authority under 40 CFR Part 148 to require fees for no migration demonstrations.

5. **Comment:** There is no reasonable degree of certainty that migration will not occur within ten thousand years because of insufficient data on the subsurface strata.

**Response:** Petitions for an exemption to the land disposal restriction include all available data to characterize the geology on both a regional and local scale. These data include well logs, geologic maps and cross-sections, laboratory data, and background information on the geology of the area. The information submitted in the Hoechst Celanese petition adequately characterized the geology of the area including the thickness, porosity, permeability, and continuity of the various strata in the injection zone and confining zone. No data were submitted contrary to the finding in the Hoechst Celanese - Bay City petition.

6. **Comment:** The petition was not made readily accessible to the public.

**Response:** The administrative record which consists of the final petition, fact sheet, correspondence, and supporting data was available throughout the comment period during normal working hours at the EPA regional office in Dallas as per 40 CFR Section 124.9. To further accommodate the general public, EPA arranged for and verified that copies of the final petition, public notice, and fact sheet were in the Texas Water Commission offices in Austin, Texas and the public library in Bay City, Texas during normal working hours throughout the public comment period from March 7 to April 20, 1990.

Hoechst Celanese - Bay City

7. **Comment:** The petition is not written in a language that the average person can understand.

**Response:** Technical terminology used in the petition is appropriate for the degree of complexity in demonstrating no migration of hazardous waste for 10,000 years.

8. **Comment:** Injection of hazardous waste is not a safe method of storage and no further injection should take place. Corporate profits should not come before public safety.

**Response:** Deep well injection is not a method of storage but is used to permanently dispose of hazardous waste. Hazardous waste injection wells are regulated under 40 CFR Part 146 and Part 148. Hoechst Celanese has met the requirements that the injection of hazardous waste will not endanger an Underground Source of Drinking Water or migrate out of the injection zone.

9. **Comment:** The waste plume movement cannot be accurately predicted and 10,000 year containment has never been demonstrated.

**Response:** Under 40 CFR Part 148, the Agency established the 10,000 year time frame standard. These regulations also allow petitioners to use predictive modeling to form the basis of a no migration petition demonstration. Issues concerning the use of the 10,000 year time and the acceptance of models were discussed in the preamble to the final 40 CFR Part 148 regulations which were published in the July 26, 1988, Federal Register.

10. **Comment:** Well bore closure does not occur naturally because the strata can and does crack and the permeability and porosity of soil can vary as much as three orders of magnitude.

**Response:** Well bore closure was not a criteria in evaluating artificial penetrations for the potential of hazardous waste migration. All wells were documented to contain drilling mud such that hazardous waste would not migrate out of the

Hoechst Celanese - Bay City

injection zone by molecular diffusion or as a result of pressure buildup due to injection.

11. Comment: Worst case should have used gravel instead of sand because it is the most permeable.

Response: Parameters used in the predictive model are based on site specific data and conservative assumptions from published literature values. The injection interval was assigned permeability values based on injectivity tests and core analysis which demonstrated that the material was sand.

12. Comment: Unless an impermeable membrane can be perfected, there is no way that no migration of hazardous waste can be demonstrated.

Response: The injection zone contains interbedded shales with a low vertical permeability based on published data. These shales act as barriers which slow vertical migration of hazardous waste due to molecular diffusion. Calculations of vertical migration of hazardous waste through sand and shale at the site is limited to 128 feet. This distance is below the top of the injection zone at 2900 feet.

13. Comment: The waste could be moving 30 times as fast as what is stated in the petition.

Response: The predicted waste plume movement in the petition is based on the combined effects of pressure driven movement during injection, natural background flow gradient, dispersion of waste, and density differences between the injected waste and formation fluid. No data were submitted contrary to the finding in the Hoechst Celanese - Bay City petition.

14. Comment: The aquifer moves at a rate of 1 ft/day or greater.

Response: Aquifers can have flow rates of 1 ft/day or greater when undergoing meteoric recharge. However, deep saline aquifers used for injection of hazardous waste approach static conditions due to the absence of active recharge or discharge. Flow rates in the petition have been

Hoechst Celanese - Bay City

conservatively estimated at 2.8 feet/year in the upper injection interval and 3.2 feet/year in the lower interval.

15. Comment: How often will the injection wells be monitored?

Response: The hazardous waste injection wells are tested for mechanical integrity annually through the use of a pressure test and a radioactive tracer survey. The well also undergoes continuous annulus pressure monitoring to ensure that no leaks develop in the well between mechanical integrity tests. The Texas Water Commission is responsible for enforcing all regulations regarding the testing and monitoring of Class I hazardous waste injection wells.

## UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

04 MAY 1990

REPLY TO: 6W-SU

MEMORANDUM

SUBJECT: Federal Register Notice - Final Decision on the  
Hoechst Celanese Chemical Group, Incorporated  
Bay City, Texas

FROM: Oscar Cabra, Jr., P.E.  
Chief  
Water Supply Branch (6W-S)

TO: Vicki Reed  
Office of Standards and Regulations (PM-223)

Attached are three originals of our Federal Register Notice and a signed original of the Federal Register Typesetting Request. This Federal Register Notice concerns the final decision on the Hoechst Celanese Chemical Group, Incorporated, Bay City, Texas, petition for an exemption to the land disposal restrictions. Please review these documents and submit them for publication at your earliest convenience. When you have an estimated date for publication, please notify us at the below listed number when the notice will be published.

If you have any questions or if any changes are necessary, please call Ronnie Crossland at FTS 255-7160 or Sharon Parrish at FTS 255-6475.

Attachments

*ph 5/3/90*

		CONCURRENCES		
SYMBOL	6W-SU	13/4/90: MALOTT: BT: C.DRIVE: CELANESE\$.MEM: FILE CODE:		
SURNAME	6W-SU	VM 5/3/90	6W-S	
DATE	S. PARRISH		O. CABRA	

(Billing Code )

ENVIRONMENTAL PROTECTION AGENCY

Underground Injection Control Program

Hazardous Waste Disposal Injection Restrictions;

Petition for Exemption - Class I Hazardous Waste Injection

Hoechst Celanese Chemical Group, Incorporated,

Bay City, Texas

AGENCY: Environmental Protection Agency

ACTION: Notice of Final Decision on Petition

SUMMARY: Notice is hereby given that an exemption to the land disposal restrictions under the 1984 Hazardous and Solid Waste Amendments to the Resource Conservation and Recovery Act has been granted to Hoechst Celanese Chemical Group, Incorporated, for the Class I injection wells located at Bay City, Texas. As required by 40 CFR Part 148, the company has adequately demonstrated to the satisfaction of the Environmental Protection Agency by petition and supporting documentation that, to a reasonable degree of certainty, there will be no migration of hazardous constituents from the injection zone for as long as the waste remains hazardous. This final decision allows the underground injection, by Hoechst Celanese Chemical Group, Incorporated, of the restricted hazardous waste specifically identified in the petition, into the Class I hazardous waste injection wells at the Bay City, Texas facility, for as long as the basis for granting an approval of the petition remains valid, under provisions of 40 CFR 148.24. As

required by 40 CFR 124.10, a public notice was issued March 7, 1990. A public hearing was held April 12, 1990, and a public comment period ended on April 20, 1990. All comments have been addressed and have been considered in the final decision. This decision constitutes final Agency action and there is no Administrative appeal.

DATES: This action is effective as of May 4, 1990.

ADDRESSES: Copies of the petition and all pertinent information relating thereto, including the Agency's response to comments, are on file at the following location:

Environmental Protection Agency, Region 6

Water Management Division

Water Supply Branch (6W-SU)

1445 Ross Avenue

Dallas, Texas 75202-2733

FOR FURTHER INFORMATION CONTACT: Oscar Cabra, Jr., Chief Water Supply Branch, EPA - Region 6, telephone (214) 655-7150, (FTS) 255-7150.

Myron O. Knudson  
Myron O. Knudson, P.E., Director  
Water Management Division (6W)

## FEDERAL REGISTER TYPESETTING REQUEST

1. TITLE

NSRA Petition Decision

Bay City, Texas  
Beechst Celanese Chemical Group, Inc.

Requestor: Complete items 1, 2, 7, 8, 9, 10, 11, 12 and 13. Retain copy number 7 and submit the balance with manuscript copy to the Hq. Federal Register Office.

HQ. Federal Register Office: Complete items 3, 4, 5 and 6. Retain copy number 6 and submit balance to Hq. Printing Management.

2. SUBMITTING ACTIVITY

3. ASSIGNED FRL NUMBER (include alpha &amp; numeric characters for identification.)

4. OPEN REQUISITION NUMBER

5. BILLING CODE

6. FORWARDED TO GSA, NARS - SIGNATURE

DATE

7. NUMBER OF MANUSCRIPT PAGES

8. ESTIMATED NUMBER OF COLUMNS

9. ESTIMATED COST  
\$250.00

## 10. FINANCIAL DATA

FMO USE (a)	D T (b)	DOCUMENT CONTROL NO. (c)	ACCOUNT NO. (d)	OBJECT CLASS (e)	AMOUNT (f)																																								
					DOLLARS	CTS																																							
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11. SIGNATURE: (a) REQUESTING OFFICER

Myron D. Knudson, Director (6W)

12. SIGNATURE: (a) FEDERAL REGISTER DESIGNEE

Marsha Glover, Budget Assistant

(b) DATE

(c) TELEPHONE NUMBER  
FTS 255-7100

(b) DATE

(c) TELEPHONE NUMBER  
FTS 255-7100

13. FUNDS ARE AVAILABLE (Commitment Clerk)

2 Pages @ \$125.00 = \$250.00

PUBLIC NOTICE OF A PROPOSED HAZARDOUS WASTE EXEMPTION

U.S. ENVIRONMENTAL PROTECTION AGENCY, REGION 6  
FIRST INTERSTATE BANK TOWER  
1445 ROSS AVENUE  
SUITE 1200  
DALLAS, TEXAS 75202-2733

The U.S. Environmental Protection Agency (EPA), Region 6, proposes to approve a petition for an exemption to the land disposal restrictions of the Hazardous and Solid Waste Amendments of 1984 (HSWA) to the Resource Conservation and Recovery Act (42 U.S.C. § 6901, et seq) for the following facility:

Hoechst Celanese Chemical Group, Inc.  
Bay City Plant  
Farm Road 3057, P.O. Box 509  
Bay City, Texas 77414

Development of the proposed decision was based on a detailed technical review of the submitted petition with support documents and consultations with the Texas Water Commission.

The HSWA Amendments provide that an exemption to these restrictions may be granted if the Administrator determines that the method of land disposal (i.e. injection well) is protective of human health and the environment. A method of land disposal may not be determined to be protective, "unless, upon application by an interested person, it has been demonstrated to the Administrator, to a reasonable degree of certainty, that there will be no migration of hazardous constituents from the disposal unit or injection zone for as long as the wastes remain hazardous" [ 42 U.S.C. § 6924 (g)(5)]. Regulations establishing the criteria for petitioning for an exemption to the land disposal restrictions were published in Volume 53, Number 143 of the Federal Register, July 26, 1988, [53 Fed. Reg., 28118, (1988)].

A final decision to approve or deny the petition for an exemption to the land disposal restrictions will be made after the close of the comment period, which ends at close of business on April 20, 1990.

All persons, including the applicant, who wish to comment on the proposed decision to approve the exemption may do so by submitting comments, along with their name and address, to the address below. All written comments must be postmarked by April 20, 1990, to be considered in formulating a final decision.

The ~~are~~  
avail ~~able~~  
throug ~~h~~  
addres ~~s~~  
availab ~~le~~  
Public ~~D~~  
of these

Bay City  
1900 5th S  
Bay city,  
(409) 245-69

Pertinent ~~EPA~~  
found in 40 ~~CFR~~

The ~~EPA~~ will ~~not~~ ~~be~~  
submitted written  
The final decision  
register.

A public hearing is scheduled at 6:30 p.m. on April 12, 1990, in the Bay City Service Center, 2105 Ave. M, Bay City, Texas. Anyone needing special provisions at the hearing site due to disabilities (i.e. interpreters for the hearing impaired, wheelchair access, etc.), is requested to contact the EPA, within ten (10) working days of the hearing date, at the address below so that these services can be provided.

Written comments, requests for information regarding the proposed decision on the petition, and requests for copies of the fact sheet (description of the reasons supporting the proposed decision) should be sent to EPA Region 6 at the following address:

U.S. Environmental Protection Agency - Region 6  
Water Supply Branch (6W-SU)  
1445 Ross Avenue  
Dallas, Texas 75202-2733  
(214) 655-7160

The administrative record for this petition decision is available for review between 8:00 a.m. and 4:00 p.m., Monday through Friday, for the extent of the comment period, at the address above. A copy of the final petition is also available for review at the Texas Water Commission and the Public Library during normal business hours. The locations of these offices are listed below.

Bay City Public Library  
1900 5th Street  
Bay City, Texas 77414  
(409) 245-6931

Texas Water Commission  
P.O. Box 13087, Capitol Station  
1700 N. Congress Ave.  
Austin, Texas 78711  
(512) 463-8281

Pertinent EPA comment and public hearing procedures may be found in 40 CFR 124.10 and 124.12.

The EPA will notify the applicant and each person who has submitted written comments of the final exemption decision. The final decision will also be published in the Federal Register.

March 4, 1990

FACT SHEET

For proposed approval to allow injection of restricted hazardous wastes into the following injection well(s):

Applicant: Hoechst Celanese Chemical Group, Inc.  
Bay City Plant  
Farm Road 3057  
P. O. Box 509  
Bay City, Texas 77414

Facility Location: Matagorda County

<u>Permit Number</u>	<u>Well Number</u>
WDW-14	2
WDW-32	3
WDW-49	4
WDW-110	1-A
WDW-277	5

Issuing Office: U.S. Environmental Protection Agency  
Region 6  
First Interstate Bank Tower  
1445 Ross Avenue  
Dallas, Texas 75202-2733

1. The Environmental Protection Agency (EPA) proposes to allow the injection of restricted hazardous wastes into the well(s) described above and in the petition demonstration document.
2. This fact sheet or similar statement of basis is required under Title 40 of the Code of Federal Regulations, §§ 124.7 and 124.8 (40 CFR §§ 124.7 and 124.8, as referenced by 40 CFR §§ 148.22 and 124.10).
3. The following is an explanation of the derivation of the proposed decision, which is categorized according to the criteria outlined in 40 CFR Part 148. [53 Fed. Reg., 28118, (1988)]

Summary

The EPA land disposal restrictions promulgated under § 3004 of the Resource Conservation and Recovery Act prohibit the injection of hazardous waste unless a petitioner demonstrates to the EPA that there will be no migration of hazardous constituents from the injection zone for as long as the waste remains hazardous. These no migration demonstrations include a description of the well operations, geologic siting, and waste stream characteristics. They also include modeling

strategies which incorporate all the above mentioned information and utilize mathematical equations to predict pressure build up and waste movement.

The Hoechst Celanese - Bay City petition described its well operation through a discussion of the well construction, well stimulations, injection pressures, and injection volumes. The site location and geologic conditions were presented through a discussion of the depositional environment, well logs, cross-sections, well tests, geologic maps, and well records. The characteristics of the injection wastestream were described and evaluated for compatibility with the injection and confining zones. Hoechst Celanese incorporated all this information into a modeling strategy which predicted the pressure build up and waste movement for the Bay City site. The waste plume, under worst conditions, was predicted to move laterally approximately 7.3 miles southeast in the upper interval and 6.6 miles southeast in the lower interval in 10,000 years. Vertical movement is approximately 128 feet. Both of these distances are within the injection zone.

In addition to the reasonably conservative data and assumptions in the no migration demonstration, the following factors were included in demonstrating no migration:

- (a) The petition over predicts pressure buildup and waste plume extent by modeling the injection rate at 750 gpm for the upper interval and 600 gpm for the lower interval which is more than the historic rate of 251 gpm for the upper interval and 190 gpm for the lower interval.
- (b) The petition over predicts the injected hazardous constituent concentration by assuming the constituent concentration is two orders of magnitude greater than the measured value.
- (c) The petition is reasonably conservative by not taking into account the degradation of the contaminant in the injection zone. Examples of degradation which were not considered are adsorption, oxidation, hydrolysis, temperature, and microbiological degradation.
- (d) In the evaluation of artificial penetrations, the petition does not take into account the natural occurrence of wellbore closure. This occurs within the Gulf Coast region due to the unconsolidated sediments.

Therefore, after a detailed and thorough review of the Bay City site petition, the EPA proposes that Hoechst Celanese

### Mechanical Integrity Testing (MIT) Information

To assure that the wastes will reach the injection zone, a petitioner must submit the results of pressure and radioactive tracer tests according to §148.20 (a)(2)(iv). A well has mechanical integrity when there is no significant leak in the casing, tubing, or packer, and when there is no significant fluid movement into an USDW through vertical channels adjacent to the injection well bore. The petition demonstrates that the active wells have been tested and do satisfy the above criteria.

<u>Well No.</u>	<u>Date of Pressure Test</u>	<u>Date of Radioactive Tracer Survey</u>
WDW-14	10-26-89	10-26-89
WDW-32	10-24-89	10-24-89
WDW-49	10-25-89	10-25-89
WDW-110	10-31-89	10-31-89
WDW-277	Not Drilled	

Injection well WDW-277 must meet the requirements of the Texas Water Commission injection permit. Results of the pressure and radioactive tracer tests must be submitted to the EPA Region 6 for approval prior to injection of restricted hazardous waste in well WDW-277. In addition, information obtained from the drilling and construction of the WDW-277 well shall be submitted to the EPA Region 6 to ensure the basis for the petition decision continues to remain valid. The information should include well logs, geologic core analysis of the confining and injection zones, a hydrogeologic compatibility determination, and formation tests.

### Quality Assurance

According to §148.21 (a)(4), the Hoechst Celanese - Bay City petition demonstrates that proper quality assurance and quality control plans were followed in preparing the petition demonstrations.

Specifically, Hoechst Celanese has followed appropriate protocol in identifying and locating records for artificial penetrations within the Area of Review. Information regarding the geology, waste characterization, hydrology, reservoir modeling, and well construction has also been adequately verified or bounded by worst-case scenarios.

### Regional and Local Geology

Class I hazardous waste injection wells must be located in areas that are geologically suitable. The injection zone must have sufficient permeability, porosity, thickness, and

M  
3/6/90**MAR 06 1990**

REPLY TO: 6W-SU

Mr. I. O. Coleman  
Hoechst Celanese Chemical Group, Incorporated  
P.O. Box 509  
Bay City, Texas 77414

RE: Proposed Petition Decision

Dear Mr. Coleman:

Based on a detailed technical review of the submitted petition with support documents and consultations with the Texas Water Commission, I am proposing to approve your petition. This petition is seeking an exemption to the land disposal restrictions of the Hazardous and Solid Waste Amendments of 1984 to the Resource Conservation and Recovery Act. Enclosed is the public notice and the fact sheet document associated with this proposed decision. A final decision regarding the Hoechst Celanese Chemical Group, Incorporated petition will be made after the end of the public comment period.

We appreciate the cooperation shown by you and your staff during the detailed petition review process. If you have any questions or comments regarding this matter, please call Oscar Cabra at (214) 655-7150.

Sincerely yours,

Myron O. Knudson, P.E.  
Director  
Water Management Division (6W)

Enclosures

cc: Michael Cook (WH-550A)  
Francoise Brasier (WH-550E)  
Russ Kimble, TWC

bcc: G Alexander, 6C  
A. Davis, 6H

## CONCURRENCES

SYMBOL	6W-SU:3/2/90:MH:kk:LAND..BAN.B::Coleman.Ltr:FILE CODE:WAT..18-6-5-9.Sec.2.....
SURNAME	6W-SU      6W-S      6C      6C-W
DATE	PARRISH      CABRA      ALEXANDER      COLLINS

## UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REPLY TO: 6W-SU

Mr. I. O. Coleman  
 Hoechst Celanese Chemical Group, Incorporated  
 P.O. Box 509  
 Bay City, Texas 77414

RE: Proposed Petition Decision

Dear Mr. Coleman:

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Sincerely yours,

Myron O. Knudson, P.E.  
 Director  
 Water Management Division (6W)

Enclosures

cc: Michael Cook (WH-550A)  
 Francoise Brasier (WH-550E)  
 Russ Kimble, TWC

bcc: G Alexander, 6C  
 A. Davis, 6H

Run a new one please

SYMBOL 6W-SU:kk:(DI\$K INFO):FILE CODE: WA				CONCURRENCES	5-9 Dec 7
6W-SU	6W-S	6C	6H	6C-w	
SURNAME PARISH	CABRA	ALEXANDER	DAVIS	COLLINS	ON
DATE 12/16/90	12/16/90			316-00	3/5

EPA Form 1320 (12-70)

**HOECHST CELANESE CHEMICAL GROUP**

**BAY CITY PLANT, MATAGORDA COUNTY, TEXAS**

**RECOMPLETE WDW-110 (WELL #1-A) IN THE UPPER MIocene**

*Prepared by:*

*Bob Hall  
Dawn Bilbrey*

*Golden Environmental Services, Inc.  
711 Louisiana, Suite 1600  
Houston, Texas 77001  
(713)228-7000*

*March 30, 1993*

*File: B:\03301392.110*



## 1.0 INTRODUCTION AND BACKGROUND

### 1.1 INTRODUCTION

This document details the recompletion operations performed on Hoechst Celanese Chemical Group Inc., (HCCG) Bay City Plant Class I waste disposal well (WDW-110). This report is developed and submitted to meet the reporting requirements of the Texas Water Commission (TWC) as set forth in the Underground Injection Control Permit granted to HCCG.

### 1.2 BACKGROUND

In October, 1992 HCCG contracted Golden Environmental Services, Inc. (GES) to re-complete WDW-110 in the upper Miocene sands. WDW-110 is permitted in two separate injection intervals-

- \* The lower Miocene sand with the permitted injection interval extending 5,700' - 5,950'.
- \* The upper Miocene sand with the permitted injection interval extending from 3,350' - 3,600'.

Previously, WDW-110 had been completed in the lower Miocene sands. The lower Miocene completion ceased to take flow and was subsequently abandoned. The abandonment operations were completed in May, 1992 and approved by the TWC shortly thereafter. The abandonment left the lower Miocene permanently sealed off and a 799' column of acid resistant epoxy cement extending 5,517'- 4,718' inside the protection casing (see Schematic I). The TWC allowed the wellbore to remain temporarily plug and abandoned, monitored with a positive pressure at the surface, to allow HCCG time to decide the ultimate disposition of the well. Figure 1.1 and 1.2 are schematics of the upper section of the wellbore prior to and after the recompletion

Operations to recomplete WDW-110 in the upper Miocene injection zone commenced on November 22, 1992 and continued until December 11, 1992, at which point the work was suspended until January 18, 1993. Field operations to continue recompletion operations were resumed on January 18, 1993. All work was completed on February 16, 1993. A weekly summary of field operations is located in Section 3.0, the detailed daily reports are located in Appendix F.



③ 12/11/92  
Hoechst Celanese

*Joe Cole*  
Chemical Group  
Hoechst Celanese Corporation  
Bay City Plant  
PO Box 509  
Highway 3057  
Bay City TX 77404-0509

December 11, 1992  
KW-235-92

Mr. Richard E. Merritt, Permits Coordinator  
Underground Injection Control Team Permits Section  
Industrial and Hazardous Waste Division  
Texas Water Commission  
P.O. Box 13087  
1700 North Congress Avenue  
Austin, Texas 78711-3087

Re: Revised (12/11/92) Edition of Proposed Procedures For  
Recompletion of WDW-110 In The Upper Miocene Sand  
Hoechst Celanese Chemical Group, Inc.  
Bay City Plant, Bay City, Texas  
Reference Letter, IOC-109-92, Dated November 11, 1992

Dear Mr. Merritt:

Revised proposed procedures for recompletion of WDW-110 in the Upper Miocene Sand are attached per your letter dated December 1, 1992 (Attachment 1) for your review and approval. Procedure numbers 7 and 9, noted with an asterisk, are revised steps in the recompletion procedure (Attachment 2).

Your earliest review and written approval of our request is appreciated.

Please don't hesitate to contact me at (409)241-4123 or Mr. I.O. Coleman, Jr. at (409)241-4197, if you have any comments and/or questions concerning the procedures.

Sincerely yours,

*Kaymartha Williams*

Kaymartha Williams  
Environmental Engineer

Attachment

cc: Mr. Ben K. Knape  
Geologist  
Underground Injection Control Section  
Texas Water Commission  
P.O. Box 13087  
1700 North Congress Avenue  
Austin, Texas 78711-3087

Mr. Joe Kordzi [REDACTED]  
UIC State Programs Section (6W-SU)  
U.S. Environmental Protection Agency  
Region 6  
1445 Ross Avenue, Suite 1200  
Dallas, Texas 75202-2733



## ATTACHMENT I



John Hall, Chairman  
Pam Reed, Commissioner  
Peggy Garner, Commissioner

## TEXAS WATER COMMISSION

PROTECTING TEXANS' HEALTH AND SAFETY BY PREVENTING AND REDUCING POLLUTION

December 1, 1992

Mr. I. O. Coleman, Jr.  
Hoechst Celanese Chemical Group, Inc.  
Bay City Plant  
P. O. Box 509  
Bay City, Texas 77404-0509

Re: Approval of Proposal to Recomplete Well Into Upper Miocene  
Injection Interval, TWC Permit No. WDW-110

Dear Mr. Coleman:

This letter is to document receipt of your proposal dated November 11, 1992, requesting approval to recomplete the above referenced well into the upper Miocene injection interval (3,350 to 3,600 feet depth). Pursuant to 31 TAC § 331.63.g., approval to commence this recompletion is hereby granted. Please note that any subsequent divergence from these approved plans will require prior authorization by the Commission.

The following item of concern is noted, however. Step 9. of the above proposal indicates the packer is to be set at a depth of approximately 3,250 feet. As discussed during our meeting of November 4, 1992, you are recommended to set the packer to a depth of at least 3,350 feet - which corresponds to the top of the permitted injection interval. If the well is recompleted as per your proposal any future leaks in the casing below the packer and above the permitted interval (3,250 to 3,350 feet depth) would constitute unauthorized injection which is a potentially serious permit violation.

Pursuant to 31 TAC §§ 331.65.b.4. and 331.65.c.1., within 30 working days of completion of the workover and subsequent testing please submit a report to the executive director completely detailing all work performed and procedures followed.

It is requested that myself, or my absence, another member of the UIC Team be informed, as soon as the information is available, of the date of mechanical integrity testing so that someone may schedule to be present to witness these phases of the operation.

DEC 1 5

Mr. I. O. Coleman  
Page 2  
December 1, 1992

ATTACHMENT I

If you have any questions, please do not hesitate to contact me at 512/908-6638.

Sincerely,



Richard E. Merritt, Permit Coordinator  
Underground Injection Control Team  
Permits Section  
Industrial and Hazardous Waste Division  
Office of Waste Management and Pollution Cleanup

RM/

cc: Brian Graves, U.S.E.P.A. - Region VI (Mail Code 6WSU)  
T.W.C. District 7 Office - Houston



## ATTACHMENT II



ATTACHMENT 2

HOECHST CELANESE CHEMICAL GROUP, INC.

Bay City Plant

Disposal Well #1-A (WDW-110)

Revised Recompletion Procedure

1. Obtain all necessary regulatory approvals.
2. Move in and rig-up daylight workover rig and ancillary equipment.
3. Nipple down wellhead, nipple-up blowout preventers.
4. Rig-up electric line equipment and run temperature log from surface to plug-back total depth (PBTD) of approximately 4,718'. Run Gamma-Ray (GR) casing collar locator (CCL) compensated neutron log (CNL) from PBTD to 13-3/8" surface casing shoe at approximately 1,396'.
5. Set standard cement plug from PBTD back to approximately 3,800'.
6. Perforate and perform isolation squeeze at an approximate depth of 3,358-3,260'. Wait on cement a minimum of 12 hours.
7. Drill out squeeze and test casing/squeeze perforations to 1,000 psig.
8. Rig-up electric line. Run control log and perforate the following intervals (all depths are approximate):

3,572-3,542' (Welex 6/04/73 IES) a minimum of 4 Jspf 90 degree phased.

DEC 16

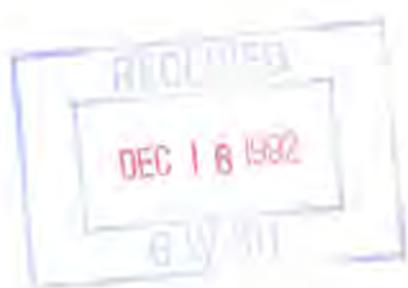
ATTACHMENT 2

3,520-3,490' (Welex 6/04/73 IES), a minimum of 4 Jspf 90 degree phased.

3,482-3,471' (Welex 6/04/73 IES) a minimum of 4 Jspf 90 degree phased.

3,442-3,376' (Welex 6/04/73 IES) a minimum of 4 Jspf 90 degree phased.

89. Set stainless steel injection packer at approximately 3,340'.
90. Run 5-1/2" carbon steel tubing to approximately 3,340'.
91. Circulate 150 barrels of 9.2 ppg inhibited packer fluid into 9-5/8" x 5-1/2" annulus. Land tubing into packer and assemble wellhead.
92. Perform acid stimulation treatment as required.
93. Perform bottom hole pressure falloff test.
94. Demonstrate mechanical integrity, perform annulus pressure test and radioactive tracer survey.
95. Prepare and submit summary report to the Texas Water Commission.



2  
*file*  
Chemical Group  
Hoechst Celanese Corporation  
Bay City Plant  
PO Box 509  
Highway 3057  
Bay City, TX 77404-0509

November 6, 1992  
KW-217-92

Mr. Mac A. Weaver, P.E.  
Chief - UIC State Programs Section (6W-SU)  
U.S. Environmental Protection Agency  
Region 6  
1445 Ross Avenue, Suite 1200  
Dallas, Texas 75202-2733

Re: Request For Extension To Response To Your Letter  
Dated October 27, 1992  
Hoechst Celanese Chemical Group, Inc.  
Bay City Plant, Bay City, Texas

Dear Mr. Weaver:

As a follow-up to the above referenced letter, we have contracted both the "No-Migration" Petition preparers (DuPont Environmental Remediation Services, Inc.) and the field testing company that performed the Mechanical Integrity Tests (Golden Strata) to provided a response to same.

Due to coordination problems associated with getting the right consulting personnel together, we request a fifteen day extension of time (on or before November 24, 1992) to submit our response.

I attempted to contact you this afternoon via telephone to no avail, to verbally request this extension. However, I was informed that you are presently in a temporary building where there is no telephone service. This letter will be faxed to your office this afternoon.

Your consideration and approval of this request are appreciated.

Please contact me via telephone at 409/241-4123 or Mr. I.O. Coleman, Jr. at 409/241-4197, if you have questions or comments concerning this request.

Sincerely yours,



Kaymartha Williams  
Environmental Engineer

cc: Mr. Phil Dellinger

UIC State Programs Section (6W-SU)  
U.S. Environmental Protection Agency  
Region 6  
1445 Ross Avenue, Suite 1200  
Dallas, Texas 75202-2733

Mr. Joe Kordzi

UIC State Programs Section (6W-SU)  
U.S. Environmental Protection Agency  
Region 6  
1445 Ross Avenue, Suite 1200  
Dallas, Texas 75202-2733

Mr. Ben Knape

Geologist  
Texas Water Commission  
P.O. Box 13087, Capitol Section  
Austin, Texas 78711-3087

NOV 06 '92 15:28 HOESCH CELANESE

P.1

Hoechst Celanese

6W-5



RUSH

HOECHST CELANESE CHEMICAL COMPANY

P.O. BOX 509, BAY CITY, TEXAS 77414

409 - 245 - 4871

FAX TRANSMITTAL

DATE: 11-6-92

TIME: 3:15 AM / PM

TO: Mac Weaver, Phil Dellinger, Joe Kordzi

COMPANY: U.S. EPA

DEPT: (214) 655-6490

FROM: Kaymartha Williams

3 PAGES (INCLUDING COVER)

If transmission is interrupted or of poor quality, please notify sender  
immediately, 409-241-4087

Our FAX number is 409-241-4086

(2)

August 27, 1992

REPLY TO: 6W-SU

Mr. I.O. Coleman  
Hoechst Celanese Chemical Group,  
Incorporated  
P.O. Box 509  
Bay City, Texas 77404-0509

Dear Mr. Coleman:

Please forward a copy of your structure map of the injection interval depicting the 10,000 year plume from your approved no-migration petition to the following agencies by September 15, 1992:

Phil Carter  
Team Leader for Surface Casing  
Texas Water Commission  
P.O. Box 13087  
Capitol Station  
Austin, Texas 78711-3087

Guy M. Grossman  
District Director  
Railroad Commission of Texas  
13201 Northwest Freeway, Suite 701  
Houston, Texas 77040-6008

These maps will be used by these agencies to alert oil and gas operators who are planning to drill or recomplete wells within your plume area. If you have any questions regarding this request please contact Brian Graves or Phil Dellinger at (214) 655-7160.

Thank you,

Mac A. Weaver, P.E.  
Chief  
UIC State Programs Section (6W-SU)

cc: Phil Carter, TWC  
Guy M. Grossman, RRC

6W-SU:BGRAVES:X7160:8/27/92:DISK:LBAN:CELANESE.BA:PLUME  
FILE CODE:

August 24, 1992  
IOC-69-92



**Chemical Group**  
Hoechst Celanese Corporation  
Bay City Plant  
PO Box 509  
Highway 3057  
Bay City TX 77404-0509

6W-S  
~~CONFIDENTIAL~~

Mr. Richard E. Merritt, Permit Coordinator  
Underground Injection Control Team Permits Section  
Industrial and Hazardous Waste Division  
Office of Waste Management and Pollution Cleanup  
Texas Water Commission  
P. O. Box 13087  
1700 North Congress Avenue  
Austin, Texas 78711-3087

**Subject:** Final Report On The Plugging And Abandonment Of The  
Lower Injection Zone Of Injection Well, WDW-110  
Hoechst Celanese Chemical Group, Inc.  
Bay City Plant, Bay City, Texas

Dear Mr. Merritt:

The enclosed subject report, documenting operations and procedures conducted to plug and abandon the lower injection zone of WDW-110, is provided for your information and records.

Please acknowledge receipt of this report in writing. Also, clarification on the monitoring requirements associated with Class 1 Injection Wells on "Temporary Abandonment" status would be appreciated.

If you have any comments and/ or questions, please contact me by telephone at (409) 241-4197.

Very truly yours,

*I. O. Coleman, Jr.*  
I. O. Coleman, Jr.  
IOC/rm

**cc:** Mr. Phillip B. Dillinger - With Attached Report  
UIC Program Section 6W-SU  
Water Supply Branch  
Environmental Protection Agency  
Region VI  
1445 Ross Avenue, Suite 1200  
Dallas, Texas 75202-2733

Mr. Oscar Cabra - Without Attached Report  
Water Supply Branch 6W-S  
Environmental Protection Agency  
Region VI  
1445 Ross Avenue, Suite 1200  
Dallas, Texas 75202-2733

(2)

JUN 11 1992

CERTIFIED MAIL P 323 411 862 RETURN RECEIPT REQUESTED

REPLY TO: 6W-SU

Mr. I. O. Coleman, Jr.  
Hoechst Celanese Corporation  
Bay City Plant  
P. O. Box 509  
Highway 3057  
Bay City, Texas 77404-0509

Dear Mr. Coleman:

We have received your request for a petition nonsubstantive revision to enable the recompletion of WDW-110 and the completion of proposed well WDW-277 into the Upper Miocene Sand (3350 to 3600 feet). Although your proposal is acceptable in concept, there are several important procedural issues that must be followed:

1. Following the recompletion of WDW-110 into the Upper Miocene, MIT data and a falloff test run according to the new guideline should be sent to this office for evaluation.
2. Assuming there are no problems with this data, the Agency will then publish notice of the proposed decision in order that the public be given a chance to comment on the new data. If sufficient interest is generated, a public hearing will then be scheduled. Because of the necessary submission of the MIT data, this application will be treated as a modification request.
3. Following the completion of proposed well WDW-277 into the Upper Miocene, the information contained in Condition Nos. 10 and 11 (e.g. MIT data, drilling information, and a falloff test), must be submitted to

6W-SU:6/10/92:KORDZI:MH:C:WP50:CELANESE\CELANESE.BA\CELBAY.LTR

6W-SU

DELLINGER

J.K. 6/10/92

PD 6/10/92

this office for review. The procedures outlined in No. 2, above will then be followed.

If you have any questions, please contact Phil Dellinger or Joe Kordzi at (214) 655-7160.

Sincerely yours,

Oscar Cabra Jr., P.E.  
Chief  
Municipal Facilities Branch (6W-M)

cc: Ben Knape, Texas Water Commission

October 11, 1991  
IOC-153-91

**Chemical Group**  
Hoechst Celanese Corporation  
Bay City Plant  
PO Box 509  
Highway 3057  
Bay City TX 77404-0509  
409 245 4871

Ms. Minnie M. Howard (6 W-SE)  
Environmental Protection Agency  
Region 6  
First Interstate Bank Tower  
1445 Ross Avenue  
Dallas, Texas 75202

**Subject:** Geographic Coordinates Of Waste Disposal Wells  
Hoechst Celanese Chemical Group, Inc.  
Bay City Plant, Bay City, Texas

Dear Ms. Howard:

Per your telephone request and information, I enclose herewith, Addendum I, which provides the geographic coordinates of the four active Waste Disposal Wells and the one recently permitted Waste Disposal Well here at Hoechst Celanese Chemical Group, Inc., Bay City Plant. As you are aware this information can be found in our No-Migration Demonstration Petition which is on file at your Agency.

Please don't hesitate to contact me at (409) 245-4871, Ext 4197 if you have any comments or questions concerning the information.

Sincerely,

*I.O. Coleman, Jr.*  
I. O. Coleman, Jr.  
Environmental Affairs Section Leader

IOC/la

Attachments

bcc: G. E. Organ ---> Environmental File No. 202.14  
R. D. Riley  
K. Williams  
C. J. Schaefer - Dallas S-M9  
G. M. Rowen - Bridgewater

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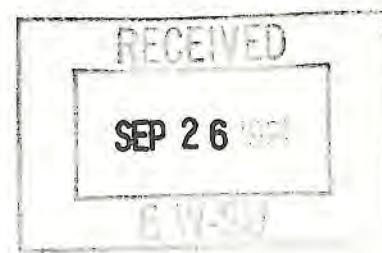
## ADDENDUM I

### Geographic Coordinates Of Bay City Plant Waste Disposal Wells

<u>Waste Disposal Well Number</u>	<u>Geographic Coordinates</u>
WDW - 14	Latitude: 28°51'19" North Longitude: 96°01'15" West
WDW - 32	Latitude: 28°51'29" North Longitude: 96°01'13" West
WDW - 49	Latitude: 28°51'24" North Longitude: 96°00'59" West
WDW - 110	Latitude: 28°51'48" North Longitude: 96°01'15" West
WDW - 277*	Latitude: 28°51'50" North Longitude: 96°01'12" West

(\*) Recently permitted, not yet drilled.

6W-S  
91 OCT22 AM10:01  
RECEIVED  
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**PETITION EXEMPTION REISSUANCE**  
**HOECHST CELANESE CHEMICAL GROUP, INC.,**  
**BAY CITY PLANT**

Prepared for:

**Hoechst Celanese Chemical Group, Inc.,**  
**Bay City Plant**  
**Bay City, Texas**

Prepared by:

**Du Pont Environmental Remediation Services, Inc.**  
**140 Cypress Station Drive**  
**Suite 140**  
**Houston, Texas 77090**

**DERS Project Number 873745 D(N)**

**Submitted February, 1991**

**Revised August 9, 1991**

**Revised September 13, 1991**

**Revised September 18, 1991**

**Revised September 23, 1991**

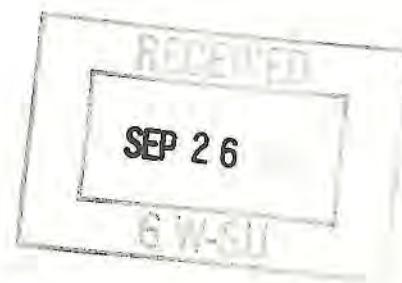
**Revised September 25, 1991**

## 6.0 MODELING

The 10,000 Year plume modeling runs were performed on both the Upper and Lower Miocene Injection Intervals using the highest and lowest, specific gravity values. All parameters used in the initial petition demonstration have been held constant with the exception of the injectate waste stream specific gravity and the dip rate. A conservative dip rate of 50 feet per 1000 feet was used in the original petition, but a dip rate of 50 feet per mile is more representative of the actual regional gradient and therefore was used during remodeling in the reissuance. The resultant plumes are shown on the approved petition structure maps and are enclosed in Appendix D. The plume plots and modeling inputs are enclosed in Appendix C. The job and the output files are contained in Appendix G.

Four specific cases are presented in Appendix C: the Upper Miocene with a low density waste of 0.998 g/cc (at 113°F bottom hole temperature (BHT)), the Upper Miocene with a high density of 1.086 g/cc (at 113°F BHT), the Lower Miocene with a low density of 0.984 g/cc (at 137°F BHT), and the Lower Miocene with a high density of 1.080 g/cc (at 137°F BHT). The Upper and Lower Miocene low density cases have been reviewed on 5 to 10 year time increments ("snapshots") during the first 50 years of post-closure, since this is when the plume will move the maximum distance updip due to buoyancy.

Results of the Upper Miocene, 10,000 Year Plume Model show that low density plume (with an initial radius of 3500 feet) will move updip a maximum distance of 5,080 feet within 5 to 10 years after injection has ended. Snapshots of the plume are included in Appendix C for time periods of 5, 10, 15, 25, 50, 250, 500, 750, 1,000, 1,500, 2,000, 3,000, and 10,000 years after injection has ended. The maximum down dip distance of the Upper Miocene, low density plume after 10,000 years is approximately 34,000 feet. The Upper Miocene, high density, waste plume has a maximum down dip extent of approximately 44,600 feet in 10,000 years (as measured from the center of the plume).



INTEROFFICE MEMORANDUM

Date: 23-Sep-1991 06:16pm  
From: DON H. SQUYRES  
SQUYREDH  
Dept: C&P  
Tel No: 713-586-5612

TO: Phil Dellinger ( PAPER MAIL )  
TO: Susie Lopez ( PAPER MAIL )

Subject: RE: EPA Requested Revisions to Cel. BCP Pet. Re-Iss. Doc.

H. Celanese Bay City Plant Petition Re-Issuance NOD's

Enclosed is a set of revised pages, based on your comments during our meeting on Sept. 13, and the several phone discussions last week.

Please insert these pages into your blue binders in place of the old pages. This will bring your current copy of the Bay City Petition Re-issuance document up to date.

I will call you Tues. to confirm that no added revisions are required, and assuming everything is final, I will send the revised additional EPA copy of the document by overnight mail (for delivery Wed).

Thanks.

Wat 18-6-5-9  
②REVIEW  
WATER MANAGEMENT DIVISION

91 SEP 12 PM 2:23

**DU PONT ENVIRONMENTAL REMEDIATION SERVICES, INC.**140 Cypress Station Drive, Suite 140  
Houston, TX 77090**DATAFAX MESSAGE COVER SHEET**DATE: 9/12TO: Phil DellingerCOMPANY: EPA Reg VI

FAX NO.: \_\_\_\_\_

FROM: Don Senges

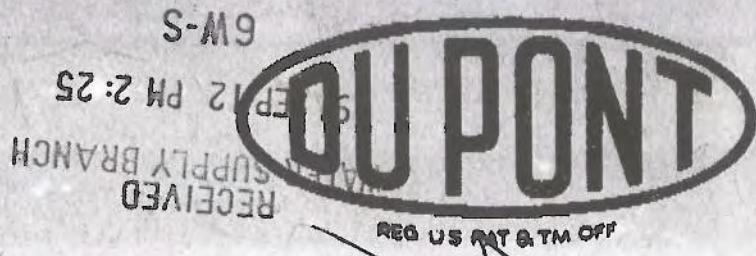
FAX NO.: (713) 586-5650

NUMBER OF PAGES INCLUDING COVER: 8

PLEASE NOTIFY DATAFAX OPERATOR AT (713) 586-5600 IF RESEND IS NECESSARY.

## COMMENTS:

Phil,  
Here is our draft revised answer to the non-  
quantitative treatment of the Calanese Bay City buoyancy  
NOD question. Does this cover the bases?



August 8, 1991  
Project Number: 873745D(N)  
Page 3

EPA Comment:

3. On Page 7 of the Petition Exemption Reissuance, Celanese presents equation 2, quantifying the effects of buoyancy on artificial penetrations. Celanese calculated a maximum buoyancy pressure of 18.2 psi. An examination of the Miller, et. al., 1986 reference paper indicated that the equation employed by Celanese to quantify the effects of buoyancy in artificial penetrations,  $P = (P_m - P_w) gh/2$ , was presented by Miller, et. al., to quantify the effects of density differences on the upward permeation driving force. The equation cited by the authors as quantifying the effects of density differences on the upward migration through defects in the confining layer (boreholes) is,  $P = (P_m - P_w) gh$ . Therefore, Celanese should recalculate the buoyancy pressure utilizing the correct formula. In addition, although this paper presents both of these equations, neither was derived. Therefore, Celanese should re-examine the applicability of the cited equation and either derive, or present a scientific paper which derives it.

Hoechst Celanese Response:

S-W-S

91 SEP 12 PM 2:25

RECEIVED  
WATER SUPPLY BRANCH

**BUOYANCY IN MUD-FILLED BOREHOLES**

EPA General Question # 3:  
(see NOD List)

**H. Celanese Response:**

A further investigation has been undertaken regarding the buoyancy issue and it is now clear that neither of the referenced equations are appropriate for calculating the buoyant force of waste fluid on a mud-filled borehole within the 10,000 year plume path after injection has ceased.

The EPA correctly points out that when referring to the reference cited, the equation without the subscript 2, does appear to be the formula that may be the one most appropriately used for buoyancy calculations through defects.

The formula with the factor of two in the denominator was derived specifically for determining the increase in vertical permeation from the waste plume in the injection zone, and represents the increased pressure on the overlying aquitard layer as a result of a density difference between the waste and the formation fluid. This increased pressure exists only in the region of the waste plume. This formula was incorrectly applied to the case of buoyancy in an artificial penetration.

A more rigorous investigation indicates that the second formula without the factor of 2 in the denominator, only applies in cases of a brine filled open borehole, or a mud-filled artificial penetration once fluid flow has been initiated by injection induced elevated injection zone pressures. Therefore, this second equation does not apply in the Hoechst Celanese case because it assumes brine filled boreholes are present or waste fluid could enter a borehole, displace the drilling mud, and thus create a situation where a lighter fluid column is present in the wellbore with the propensity to buoyancy.

S-109  
12 SEP 16  
RECEIVED BY RAY WATERS

rise. At the Bay City Plant, all wells within the 10,000 year plume path have been investigated and all abandoned wells have the documented presence of drilling mud in them. A chart attached to the latter portion of this discussion presents each well in the plume path and the source of data indicating the mud plugging documentation. This documentation is also included as an attachment to the Petition Re-Issuance document. Thus, because all wells are properly plugged, and the hydrostatic head of the mud columns is always greater than the injection interval pressures, it is the Hoechst Celanese position that waste or formation fluid could not enter the wellbores <sup>and therefore</sup> buoyancy driven flow does not occur.

waste from entering wellbores due to buoyancy.  
Factors which help prevent buoyant flow from occurring in abandoned boreholes are:

- 1) Low permeability, drilling mud derived filter cake will usually be present along a mud filled open borehole providing a mechanical barrier to fluids entering or exiting the borehole;
- 2) Drilling muds are specifically designed so that the clay platlets and other components in the mud will not exit an open borehole into a formation and thus there is no process by which the mud would leave the borehole and be replaced by waste fluid;
- 3) Even if some mud that was in proximity to the waste plume were to leave the borehole by some process, the overbalanced mud column would immediately force new mud downward to replace it;
- 4) Most of the wells in the Hoechst Celanese 10,000 plume path <sup>care</sup> either cased, or have cement plugs and mud in them (or both) creating a closed system, and fluid entry into the wellbore would be prevented by the mechanical barrier of the well casing or by the inability of the entering fluid to "levitate" a cement plug in order to create space for waste fluid to enter the borehole. Even in a worst case scenario, where mudcake was absent and the casing corroded, the hydrostatic head of the mud

RECEIVED  
MATERIALS SUPPLY BRANCH  
SF 12 PLT 67  
FBI - BOSTON



DRAFT

PETITION EXEMPTION REISSUANCE  
HOECHST CELANESE CHEMICAL GROUP, INC.,  
BAY CITY PLANT

Prepared for:

Hoechst Celanese Chemical Group, Inc.,  
Bay City Plant  
Bay City, Texas

Prepared by:

Du Pont Environmental Remediation Services, Inc.  
140 Cypress Station Drive  
Suite 140  
Houston, Texas 77090

DERS Project Number 873745 D(N)

Submitted February, 1991  
Revised August 9, 1991

Wat 18-6-5-9

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